PDF

BIBLIOGRAPHY OF

COATING PROCESSES

TECHNICAL RESOURCES

1995

ASSOCIATION FOR FINISHING PROCESSES
OF THE
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ASSOCIATION FOR FINISHING PROCESSES
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SME TECHNICAL RESOURCES IN PAINTS AND COATINGS

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ABBREVIATIONS

The following abbreviations are used in accession numbers in this bibliography.

AD Assembly interest area. Indicates a Technical Paper.
AP April *Manufacturing Engineering*
AU August *Manufacturing Engineering*
B Books
CM Casting, Molding interest area. Indicates a Technical Paper.
DE December *Manufacturing Engineering*
EE Electrical and Electronics Manufacturing. Indicates a Technical Paper.
EM Engineering Materials interest area. Indicates a Technical Paper.
ER Education Report. Indicates a Technical Paper.
FC Finishing and Coating interest area. Indicates a Technical Paper.
FE February *Manufacturing Engineering*
IQ Inspection and Quality Control interest area. Indicates a Technical Paper.
JA January *Manufacturing Engineering*
JL July *Manufacturing Engineering*
JM Indicates an article from the *Journal of Manufacturing Systems*
JU June *Manufacturing Engineering*
MA March *Manufacturing Engineering*
MF Material Forming interest area. Indicates a Technical Paper.
MM Manufacturing Management interest area. Indicates a Technical Paper.
MR Material Removal interest area. Indicates a Technical Paper.
MS Manufacturing Systems interest area. Indicates a Technical Paper.
MYH May *Manufacturing Engineering*
NA North American Manufacturing Research Conference
NO November *Manufacturing Engineering*
OC October *Manufacturing Engineering*
PE Product Engineering interest area. Indicates a Technical Paper.
SE September *Manufacturing Engineering*
TE Tool Engineering interest area. Indicates a Technical Paper.
VT Videotape

How To Use This Bibliography

This bibliography provides a useful file of current resources available from the Society of Manufacturing Engineers. The SME materials listed include Technical Papers, Books, and Videotapes, as well as periodicals: the *Journal of Manufacturing Systems* and *Manufacturing Engineering*.

Each abstract in this bibliography is also listed electronically on the SME INTIME® (Information on Technology In Manufacturing Engineering) Data Bank. INTIME includes application information dating back to 1974. Computerized searches of this data file are available by contacting the Computerized Automation and Robotics Information Center (CARIC) at (313) 271-5340.

Listed below and on the following page are sample abstracts with a brief explanation of each of the citations.

Technical Papers

TITLE — **Reactive Hot Melt Adhesives For Automatic Bonding**

AUTHOR — Kimball, Michael E.

AUTHOR AFFILIATION — W.R. Grace,
Teroson Automotive Division

ORDER CODE — AD900126 13P

NUMBER OF PAGES, YEAR OF PUBLICATION, INTERESTS AREA*

ABSTRACT

An epoxy reactive hot melt adhesive is described by the results of lap shear bond testing before and after environmental aging. Because of the adhesive's high flexibility, some unusual results were observed.

*Interest Areas

AD	Assembly	ER	Education Report	MR	Metal Removal
CM	Casting, Molding	FC	Finishing, Coating	MS	Manufacturing Systems
EE	Electrical and Electronic Manufacturing	IQ	Inspection, Quality Control	PE	Product Engineering
		MF	Material Forming	TE	Tool Engineering
EM	Engineering Materials	MM	Manufacturing Management		

Journal of Manufacturing Systems

ARTICLE TITLE — **Estimating Cycle Time In Design For Robotic Assembly**

AUTHOR — Carter, Perry W.

AUTHOR AFFILIATION — Brigham Young University

LOCATION CODE — JM910001 Vol. 9, No. 1, Pp 1-12

VOLUME NUMBER, PAGE NUMBERS

ABSTRACT

The design for robotic assembly handbook offers a method for quantitatively evaluating a product's ease of assembly by robotics, and helps the designer estimate the cost of assembly associated with each part. Robot assembly task time data derived from laboratory tests and industrial experience, can be substituted for the original values on the handbook data sheets for estimating part assembly times at a two-arm robotic assembly station. Using these new time values, the handbook method yields cycle time estimates that are within 5% of those

drawn from computer simulation.

North American Manufacturing Research Conference (NAMRC)

TITLE **A New Reformed Shell Forming Process**

AUTHOR Biondich, Scott C
Dick, Robert E.

AUTHOR AFFILIATION Alcoa Laboratories

LOCATION CODE NA900033 Pp 33-40 **PAGE NUMBERS**

A new forming process for shell manufacture is described and compared with conventional technology. The process/product offers significant savings and an extremely short payback period, while maintaining quality and performance. FEM models were used to study process and product performance, and the results are compared with experimental data.

ABSTRACT

Videotapes

TITLE **Trends In Superabrasives and Precision Grinding**

AUTHOR Bollinger Steve,
Jacobsen, Jane

AUTHOR AFFILIATION Society of Manufacturing Engineers
JBJ Technical Communications

LOCATION CODE V9039101

Dr. Richard Lindsay, of the Norton Company, discusses the basics of precision grinding and superabrasives in the first section of this manufacturing insights videotape.

ABSTRACT

Books

TITLE **Pressworking Terminology**

AUTHOR Smith, David A. Editor

Die Design Handbook **BOOK TITLE**

LOCATION B1555C01 Third Edition,Pp 1-1--1-10 **PAGES**

An alphabetical list of terms used in pressworking gives detailed descriptions and definitions.

ABSTRACT

Periodicals

TITLE **Make Money With Multicoats**

AUTHOR Coleman, John R.

AUTHOR AFFILIATION

Manufacturing Engineering
90JA0038 Vol. 104, No. 1, Pp 38-42

VOLUME, NUMBER PAGES

Different machining operations call for different substrate properties. Today's carbide inserts with combinations of protective coatings handle most metalcutting jobs with ease. As metalworking moves toward more efficient machining, reduced downtime and minimum tool inventory, look for more combinations of coatings on specially designed substrates.

ABSTRACT

COATING APPLICATIONS FOR CONTAINERS

POWDER AND EXTRUSION COATINGS – THE ROLE OF 100% SOLIDS TECHNOLOGY IN THE PACKAGING COATINGS

McPherson, Michael A.
Dexter Packaging Products

The role of powder and extrusion coatings used in the metal container industry is reviewed. Current progress of powder coatings is discussed, including technical limitations, application issues, current equipment and spray issues, and future equipment development. Technical issues such as required film thickness, uniform spray distribution, and ultra fine powders are outlined – with supporting data and illustrations. Extrusion coating is presented as the future of the metal container industry. An overview of the extrusion coating process is provided, and its application to 2pc and 3pc containers is discussed. The relative economics of extrusion, lamination, powder and liquid coatings are also reviewed.

LIQUID COATINGS

WATERBORNE PAINT CIRCULATION

Peter J. Bankert
Graco, Inc.

Waterborne coatings are a popular choice for automotive topcoats because they offer reduced V.O.C. and improved appearance. These materials have significant differences when compared with the high solids solvent borne coating they replace. This paper addresses some of the key issues with waterborne coatings including: corrosion, agglomeration, viscosity, shear degradation, aeration, skinning, fluid velocity, and electrostatics.

ADVANCES IN ROTARY ATOMIZER DESIGN FOR REAL WORLD APPLICATIONS

Michael P. Hansinger, PE
Nordson Corp.

New design features for the Rotary Atomizer make this spray device a perfect option for painting all types of products. These features allow the device to be operated with higher transfer efficiencies, to be smaller in size, to be more robust, and to be industry standard safe.

SPRAY EQUIPMENT CONSIDERATIONS FOR WATERBORNE COATINGS

Keith R. Whiting
ITW Ransburg Electrostatic Systems

No abstract available.

ADVANCED FLUSHABLE TUBULAR ANODES FOR CATIONIC ELECTRODEPOSITION

W. James Allshouse
Koch Membrane Systems, Inc.

Conventional flat membrane anode boxes are rapidly being replaced by advanced flushable anodes on existing cationic electrocoat lines. For new installations, the flushable tubular anode has become the industry standard due to its ease of installation, maintenance and improved operation performance. Advanced flushable tubular anodes will be compared, in several installations, to conventional flat membrane boxes from an operating cost and film build improvement standpoint. Both vertical and horizontal designs will be discussed.

MECHANICAL METAL FINISHING

NYLON ABRASIVE FILAMENT (NAF) BRUSHES – AN ALTERNATIVE TO DEBURRING, EDGE RADIUSING AND SURFACE FINISHING PROBLEMS

Prasad S. Mahadev
Weiler Brush Company

NAF brushes solve many deburring, edge radiusing and finishing problems. Their compliancy and filamentary nature accommodate part contours, prevent damage to value added components and make them ideal candidates for robotic and automated work stations. NAF brushing is constantly evolving to cope with the increasingly stringent requirements of manufacturing such as shorter cycle times, tighter part tolerances improved finishes, precise edge radii, and lower finishing costs. Applications include deburring/edge radiusing of carbide inserts, aluminum extrusions, gears, blanked steel parts and automotive components such as camshafts, transmission parts, wheel rims and engine cylinder heads.

DRYBLAST SURFACE PREPARATION FOR DIVERSE COATINGS

John C. Carson

Guyson Corporation

The application of automatic blast treatment methods in cleaning, conditioning texturing and stripping as a preparation of surfaces for various coatings is discussed. Operating principles of airblast and turbine-blast delivery systems are briefly reviewed, the surface modification effects of shot and grit media are described, and the capabilities of more recently developed blast materials are introduced. The importance of laboratory testing and follow-up coating test evaluation is emphasized as the basis for decisions about media and blast process parameters.

PAINTING & COATING PLASTIC SUBSTRATES

ROLE OF MOISTURE IN PROCESSING, APPLICATION AND CURE OF 2K POLYURETHANE COATINGS

James D. McGinness
Red Spot Paint and Varnish Co., Inc.

Moisture plays some role in all aspects of processing 2k polyurethane coatings. It is important to understand exactly where moisture must be avoided, where it is of little concern, and indeed where it might be of benefit. The purpose of this paper is to provide that information in an understandable manner. Probably the least understood aspect, and perhaps the most useful, is the knowledge of the role moisture can play in the cure process and how much humidity varies from summer to winter.

LOW BAKE WATERBORNE BASECOATS FOR HEAVY TRUCKS AND RIGID, LOW BAKE PLASTICS

Michael C. Knight
T. J. Lepkowski
BASF Corporation

The heavy truck industry is split on the use of high bake crosslinked topcoat technology versus low bake topcoat technology. Numerous rigid plastics, both thermoset and thermoplastic, are used in the heavy truck industry. It is this variety of substrates that necessitates a technology that conforms to a lower bake schedule. The requirements for the low bake technology are just as demanding as those for the high bake technologies. The capability to multi-tone, multiple layers of basecoat before a single layer of clearcoat, is an additional unique opportunity for the heavy truck industry. Waterborne basecoats, while meeting the requirements of the heavy truck industry, offer the ultimate appearance with the lowest VOC. This paper describes the development and commercial attributes of a unique product line of acrylic waterborne basecoats. The system meets a low bake requirement with the ability to be masked and "multi-toned" followed by a single clear overcoat. The film performance properties meet the typical requirements for the large truck industry as well as much of the low temperature tolerant automotive plastic sector. This system provides excellent exterior durability, low organic solvent content and class A type appearance.

IN-MOLD COATING OF RIM INJECTED POLYURETHANES – A SENSIBLE ALTERNATIVE TO POST FINISHING

Richard B. Harper
Lilly Industries, Inc.

An overview of available in-mold coating technologies along with the advantages and disadvantages of each. Also included are the advantages of in-mold coating versus post finishing of RIM injected polyurethanes.

POLLUTION PREVENTION

OPERATION OF A "CLOSED" SOLVENT PAINT SPRAY BOOTH AND DETERMINATION OF THE FEASIBILITY OF ZERO AQUEOUS DISCHARGE

David B. Mitchell
Gene V. Wayman
Steven M. Deboo
Mack Hobson
Donnie Sexton
Richard Sparks
Grace Dearborn

Harman Automotive operates a solvent paint spray booth with periodic blowdown. Every 2-3 months the paint booth sumps are completed drained and 10,000 gallons of water trucked off site for treatment. The frequency is determined by the occurrence of parts rejects, plastic side mirrors, exceeding acceptable levels. A project was initiated to reduce costs associated with both parts rejects and paint booth water disposal. The feasibility of a fixed film bioreactor was evaluated to allow continuous operation of a zero aqueous discharge paint system.

AN EXPERT SYSTEM FOR METAL PARTS AND PRODUCTS PAINTING

Dean R. Cornstubble
Jesse N. Baskir
Michael Kosusko
Research Triangle Institute

Corrosion protection and pleasing visual appearance provide incentives for metal parts manufacturers to paint their products. Unfortunately, many conventional liquid paints contain substantial quantities of organic solvents that evaporate during curing operations

The objective of this work is to develop a computer-based program and information source that coating users, and those providing technical assistance to them, can use to select technically innovative, cost-effective, and low-polluting coatings. The expert system contains questions relating to existing coating applications, alternative coating technologies, coating alternative rankings and an information source. Source information includes: general information; performance; equipment; operator and economic considerations; environmental information; and references.

POWDER COATINGS

AUTOMATION COST JUSTIFICATION FOR TODAY'S POWDER FINISHER

Cynthia A. Skelton-Becker
Sergey Guskov
Nordson Corporation

Until the early 90's, cost justification for powder coating was often made based on capital investment costs and EPA requirements. Once powder was chosen, powder application and booth equipment were the only factors to consider. Today, there are many process automation and control alternatives to consider. A modern finisher can look at each alternative's features in terms of finish, reject rate reduction, material and energy saving. Cost justification is a process of calculating the savings and/or increased revenues realized. This paper analyzes some benefits of powder process automation that should be considered. It also provides guidelines for estimating savings which can be realized from those features.

POWDER PARTICLE SIZE MANAGEMENT . . . ON THE COATING LINE

Paul R. Horinka
Morton International

The particle size of a powder coating plays an important role in many of its application properties. Powder as provided by the manufacturer is only the starting point. Many coating line factors result in an on-line change in particle size. Some of these are related to application equipment type, system operation and maintenance. Maximizing transfer efficiency and understanding the effects of size change can help the coater achieve greater control over the coating process. The benefits of such control include a more consistent and high quality product as well as cost savings from improved efficiencies.

FLAT-LINE POWDER COATING APPLICATIONS

John J. Binder
Nordson Corporation

Most everyone involved with an industrial finishing application or working in an industrial finishing environment is familiar with the powder coating process to some degree. But what exactly is flat-line powder coating? It is essentially the powder coating of two-dimensional and three-dimensional parts conveyed on a flat belt conveyor or suspended through the booth and conveyed horizontally. Typically, three dimensional parts powder coated "in the flat" are parts that were previously hung vertically. In addition to three dimensional parts, flat-line powder coating may in many cases be the only viable method for applying powder to a two-dimensional substrate.

POWDER FLOW CONTROL FOR AUTOMOTIVE SYSTEMS

David L. Moses
Nordson Corporation

Powder coating applications have been increasingly accepted by the American Automotive Industry. With anti-chip and primer surfacer coatings already in production and powder clear coat not far off, the demand for improved process control is growing. A powder flow control system is now available that improves the consistency and reliability of powder deposition.

POWDER BOOTH FAN PERFORMANCE AND AIRFLOW CONTROL

Michael A. Reighard
Nordson Corporation

The fan performance and the control of the booth airflow is important to the powder coating process. The fan curve, which represents the fan

performance by plotting the pressure and horsepower versus fan speed, is necessary for sizing a fan for a powder coating operation. Variations in the system will effect the booth airflow and the powder coating operation. By controlling the airflow in the booth, energy consumption and sound level can be reduced and the transfer efficiency improved. This paper will discuss the fan performance and it's role in the powder coating system. The automatic airflow control systems and their benefits will also be covered.

QUALITY

HOW TO DEVELOP EFFECTIVE PAINT/FINISHING SPECIFICATIONS

Raymond J. Salley II
Blue Bird Corporation

No abstract available.

ISO9000: IF YOU HAVEN'T STARTED, YOU'RE BEHIND

Kurt R. Weamer
Baycote Metal Finishing

No abstract available.

SPECIALTY COATINGS

PHYSICAL VAPOR DEPOSITION CORROSION AND WEAR RESISTANT HARDCOATINGS

Mark Podob
Richter Precision Inc.

Physical Vapor Deposition (PVD) is a group of coating processes used to apply functional hardcoatings and decorative thin films. These coatings include titanium nitride (TiN), titanium Carbonitride (TiCN), zirocnium nitride (ZrN), and chromium carbide (CrC). The coatings are very hard, have a low coefficient of friction, and are chemically resistance. Functional applications include the metalworking industry, for extending the life of cutting and forming tools. TiN is a replacement for chromium plating and electroless nickel commonly used on plastic molds, gates and other components. In the medical industry, the coatings are applied to both orthopedic prostheses as well as surgical tools. Decorative applications include watch components, eyeglass frames, pen parts, door and window hardware, and plumbing fixtures. Coating properties, processes, and applications are reviewed.

NEW COATING TECHNOLOGY AND PROCESS

Gary K. Sweet
Applied Polymer Systems

Thermal spray coating on large components and composite substrates using recently developed thermoplastic and thermoset powder is available in today's marketplace. This small, but growing, technology has been around since the 1980's, but it is now gaining momentum. Improvements in equipment able to heat, melt, and discharge polymer powder materials, some with fillers such as powdered metal and ceramics allow operators to coat metal, wood, plastics, composites, glass and even paper with high performance coatings. For years, powder coatings could only be applied successfully in a shop environment. Even then, large components which did not fit into a cure oven could not be processes. The recent emergence of new process equipment and powder coating materials has changed this line of thinking.

SURFACE PREPARATION

FISH EYE AND CRATER MYSTERY SOLVED

Denver L. Ezell
Calgon Corporation

No abstract available.

SYSTEMS DESIGN/ PROCESS IMPROVEMENT

NEW ADVANCEMENTS IN HVLP ELECTROSTATICS

Joel D. Rupp
ITW Ransburg Electrostatic Systems

This paper covers the many facets of electrostatic spray guns. Included is the evolution of electrostatic guns, the benefits of HVLP and electrostatics, cost justifications for purchasing HVLP electrostatics (emission reduction, paint savings, and labor savings). Also covered are the new technologies available in today's HVLP electrostatic spray guns.

UTILIZATION EFFICIENCY
Robert Johnson
Nordson Corporation

No abstract available

SPRAY BOOTH MONITORING FOR PROCESS IMPROVEMENT
John Dittmar
Omega Produtive Services, Inc.

Maintaining optimum environmental conditions in a spray booth is essential to produce a consistent quality paint finish with optimum energy and paint consumption. Main variables of the spray booth environment include: temperature, humidity, downdraft and booth balance. In turn, these parameters are controlled by burner and humidifier capabilities, supply fan rpm's, exhaust static pressures and booth water flow.

AGILE EDGE FINISHING SYSTEMS
Mark A. Powell
Sandia National Laboratories

This paper describes a project undertaken by Sandia National Laboratories to develop an agile, automated, high-precision edge finishing system. The project involves redesigning and adding additional capabilities to an existing finishing workcell. The resulting workcell will serve as a prototype for production systems that will be integrated into highly flexible automated production lines. The system will use advanced path planning, burr predition expert systems, automated process definition from a process database, and a hybrid fuzzy logic-classical control scheme to achieve Sandia's performance goals. In this paper, we discuss the progress and the planned system development under this project.

SINGLE SOURCE CAPABILITY
Dr. Paul H. Pettit, Jr.
PPG Industries

In response to environmental legislation and other factors, many companies are facing the need to change the way they paint their products. One option to consider when deciding which one of many finishing technologies is preferred is to involve a coating supplier who offers total source capability/

AUTOMATED ROBOT INSPECTION OF SPRAY PAINTED SURFACES
Ann T. Wilkey
John W. Schwarz
Sandia National Laboratories

Applications of paints and coatings can be greatly enhanced through the use of robotic spraying. Benefits include increased application rates with tighter control over coating finish, quality and costs. The use of robotics can reduce human exposure to hazardous materials and dangerous spray environments. Successful deployment of a robotic system requires process feedback, automated task and path planning, and teleoperation. This paper describes a measurement system consisting of an inspection sensor and automated path planner for automated robot inspection of painted surfaces. The inspection sensor includes both ultrasonic and eddy current components configures in a mechanism providing both compliant force and compliant motion.

ULTRAVIOLET (UV) COATINGS AND CURING APPLICATIONS

UV COATINGS: THE BASICS
Janet Markus
David Satzger
The Dexter Corporation

Ultraviolet light curing is a process that uses ultraviolet light to promote the polymerization of a liquid coating, ink or adhesive into a solid. This paper describes the basic chemistry of UV coatings and how these materials are cured. Also discussed are light sources, application considerations, curing parameters and health and safety guidelines.

ENVIRONMENTAL COMPLIANCE

A Case History of VOC Emission Control for Plastic Auto Parts Painting
Kenson, Robert E.
Met-Pro Corporation
FC930408 15P

A supplier designed and built a quality facility to supply auto plants with plastic part assemblies. Manual painting solvent emissions were permitted without controls as long as transfer efficiency and paint usage/VOC content limitations were met. Unfortunately, quality finish for the parts could not be maintained without exceeding these limitations. The air pollution absorber/concentrator as the best approach for VOC emission control for the paint booth emissions.

Understanding the Chemical Treatment of Solvent Paints and Extrapolations to Waterborne Coatings
Mitchell, D.B.
Deboo, S.M.
Tonn, G.A.
Grace Dearborn
FC930409 25P

The introduction of Waterborne paints has increased concerns about their treatment. This may be a consequence of both rumors surrounding Waterborne coatings, together with past negative experiences in treating solvent paints. This paper discusses omissions in the understanding of solvent paint systems and why simple extrapolations to treat Waterborne coatings would be unadvisable.

Inorganic Membranes for Cleaner Bath Recycling and Oily Wastewater
Fischer, Allan P.
Eisenmann Corporation
FC930410 19P

Over the last 10 years in Europe, and more recently in North America, inorganic membranes have made inroads in overcoming the limitations of polymeric membranes in cleaner bath recycling and oily wastewater treatment. This paper will examine the use of inorganic membranes for cleaner bath recycling and oily wastewater treatment in both Europe and North America and will show them to be an effective and economical way to help achieve waste minimization, chemical recovery, resource conservation, and energy reduction.

Waste Treatment as an Integral Part of Paint Finishing
Horton, D. Mark
George Koch Sons, Incorporated
FC930411 31P

This paper identifies waste sources from finishing systems and the treatment of all discharge solutions. It reviews permitting requirements, laws, and regulations, discusses waste sources with design considerations in their reductions with paint finishing systems, and provides a basic overview of the chemical treatment process of waste disposals.

COATING TYPES

Getting from Wet to Dry
Reddy, Vishu
Nordson Corporation
89JU0083 Vol. 102, NO. 6, PP 83-86

Powder systems have a demonstrable advantage over wet systems in two key components of operating costs--material and energy. A comparison between the operating costs of liquids and powders is presented. Thermosetting powder properties and application are discussed.

Organic Coatings
Cubberly, William H.
Cubberly & Associates
Bakerjian, Ramon
Society of Manufacturing Engineers
B1419C49 PP 49-1 - 49-15

Organic Surface Coatings are complex mixtures of materials designed to enhance the appearance of and/or to protect a substrate. The coating itself is normally composed of a number of ingredients including (1) The polymer (binder) which is designed to provide the major properties of the coating; (2) Solvents, which are used to adjust the viscosity of the coating primarily for

application; (3) Pigments, which are designed to hide the substrate, provide decorative color, and enhance specific desired properties in the coating, such as corrosion resistance; and (4) Additives, which include materials such as thickeners, flow agents, catalysts, inhibitors, and stabilizers.

Plating
Cubberly, William H.
Cubberly & Associates
Bakerjian, Ramon
Society of Manufacturing Engineers
B1419C47 PP 47-1 - 47-14

Electroplating is an electrolytic process whereby a metal is cathodically deposited onto another metal or a surface that has been made conductive, thus, a part made of metal, plastics, or other materials may be coated with a thin metal deposit to impart certain desirable properties while avoiding the prohibitive cost of fabricating the part entirely from the metal used as a coating. Plating provides desirable characteristics such as protection of the basis metal (substrate) from corrosion, improvement of the appearance of the substrate, and improved solderability, wear resistance, electrical conductivity, contact resistance, and lubricity, depending on their use, electroplated coatings may be classified as either decorative or engineering, with some falling into both classifications.

Inorganic Coatings
Cubberly, William H.
Cubberly & Associates
Bakerjian, Ramon
Society of Manufacturing Engineers
B1419C48 PP 48-1 - 48-27

Conversion coating, sometimes referred to as chemical reaction priming, is the formation of a coating on a ferrous or nonferrous metal surface as a result of controlled chemical or electrochemical attack. The converted surface is not superimposed on the underlying metal, such as a paint coating, but is rather a strongly adherent chemical entity formed at the interface by inter-action between the chemical coating solution and the ions formed from the metallic surface immersed in the solution. The two most common methods of applying conversion coatings are spraying and immersion.

Levelling Modulated Substrates by Electrodeposition Resistive Masks
Landau, Uziel
Angus, John C.
Case Western Reserve University
Kaplin, David
Case Western Reserve University
B1501611 PP 611-614

Earlier work on generating modulated surface features by plating through resistive films has been extended to include the complimentary process of levelling metallic substrates by plating, described here is a novel, two-step process which provides unique, self-levelling capability to conventional electroplating. First, a polymeric resistive film is electropolymerized onto the substrate. Field variations associated with substrate perturbations modulate the film thickness. This resistive film controls the amount of (thickness) of metal which is electroplated through it. Initial exploratory experiments prove the feasibility of the process.

Introduction
Dawson, Sam
Reddy, Vishu
Editor
B1664C01 First Edition PP 3-19

Modern powder coating technology can produce a quality finish that rivals liquid coatings while offering superior surface properties, powder coating systems are relatively easy to justify, the industry is actually realizing benefits from the recent mass or environmental legislation, by offering a means of coating articles without many of the financial penalties, business constraints, and product performance compromises often resulting from such legislation. Two papers.

Powder Coating and their Applications
Dawson, Sam
Reddy, Vishu
Editor
B1664C02 First Edition PP 23-79

Current and future applications of powder coatings, and developments in lower temperature and faster curing, are described. Powder coatings are used in precoat and primer applications and in the appliance, automotive, and building industries. Ten papers.

Pretreatment for Powder Coatings
Dawson, Sam
Reddy, Vishu
Editor
B1664C03 First Edition PP
83-107

Maximizing the good qualities of powder coating requires effective pretreatment, proper pretreatment enhances the powder coating finish. Cleaning, phosphatizing, rinsing, and other aspects of pretreatment are discussed. Three papers.

Powder Spray Technologies and their Selection
Dawson, Sam
Reddy, Vishu
Editor
B1664C04 First Edition PP
111-146

Powder spray technologies, recovery systems, color change techniques, and a systems approach to powder finishing controls are presented in four papers.

Quality Control and Testing of Powder Coatings
Dawson, Sam
Reddy, Vishu
Editor
B1664C06 First Edition PP
169-186

Tests used with solvent-based coatings are not usually relevant to solventless powder coating systems. Sophisticated equipment is available which can assess the behavior of powder coatings. The quality connection between supplier and applicator is essential to successful powder coating. Two papers.

Maintenance and Efficiency in Powder Coating Systems
Dawson, Sam
Reddy, Vishu
Editor
B1664C07 First Edition PP
189-204

Automotive assembly plants that have established just-in-time inventory scheduling have placed new demands for efficiency and precision on the powder coating industry, and require new methods of maintenance scheduling to avoid downtime. Programmable controllers are being used to reduce downtime and rejects. Transfer efficiency and waste reduction are discussed. Five papers.

Safety and Site Selection
Dawson, Sam
Reddy, Vishu
Editor
B1664C08 First Edition PP
207-221

The major hazards in powder coating are exposure to toxic materials and the risk of fire or explosion. Preventive measures are presented. Details of powder coating site selection and construction are discussed. Two papers.

Developments and Trends in the Powder Coatings Industry
Dawson, Sam
Reddy, Vishu
Editor
B1664C09 First Edition PP
225-259

New and updated methods of powder coating various substrates are discussed, including in-mold powder coating, preheating, pretreatment, new paint development, and dry powder porcelain enameling. Five Papers.

New Developments in Mar Resistant Coatings
Thread, Shane E.
Red Spot Paint and Varnish Company, Incorporated
EM890186 6P

Two types of mar resistant coatings are described. Both coatings--one suedelike, one leatherlike--can be used as inexpensive substitutes for leather or vinyl wrap-around. They have a texture and feel that offer stylists an alternative in plastic coating. The suedelike coating provides ultra-low gloss while the leatherlike coating affords a wide range of glosses.

Coating Plastic Parts with Electrostatic Equipment
Chambers, Tim
Nordson Corporation

EM890188 12P

As the Environmental Protection Agency continues to mandate a cleaner atmosphere, more and more companies are eliminating in-house coating or are being forced to comply with these government regulations and to utilize a cleaner, safer process. One solution that satisfies this mandate is the electrostatic finishing process. This paper discusses electrostatic theory, types of plastics, hooks and hanging arrangements, prep coats, and application methods and equipment.

New and Unique Electro-Conductive Pigments
Lippincott, Chuck
C. Withington Company
EM890516 8P

Mitsubishi Metal Corporation has developed a series of conductive powders directed toward a variety of applications where non-carbon blacks are required. These materials can be used in conductive systems ranging from static control to EMI and RFI shielding. Some of the products also have unique pigmentary properties for applications not requiring conductivity.

High-Volume/Low-Pressure (HVLP) Turbine Spray for Plastics
Bunnell, Michael H.
Can-Am Engineered Products
EM890517 13P

An overview of the turbine spray (HVLP) technology and how it works is presented. Working perspective of HVLP is discussed in comparison to high pressure style spraying systems. Because of environmental trends a section is devoted to applicability to the new high solids style coatings. Application emphasis is on how the attributes of turbine spray technology fit the needs of spraying plastic parts and specifically automotive style parts. The unique characteristics of this non-electrostatic system with a soft/gentle spray pattern in relations to parts with recesses and cavities is discussed. Recent regulatory views on HVLP technology are also presented.

Abrasion Resistant Clearcoats for Automotive Plastics
Gheyara, Vistasp N.
Wagner Division, Cooper Industries
EM890518 5P

This presentation will discuss performance requirements and processing and testing of four different coating technologies currently available on the market for abrasion resistant clearcoats for automotive plastics. Comparison of the UV curable polysiloxane, polyester and CFI technology regarding abrasion resistance, outdoor weathering, and cost will be detailed to bring out the disadvantages and advantages of each system.

New Concepts for Premold Powder Coating of Compression Molded Plastic
Duda, Edward J.
Corcoran, Everard B.
Ferro Corporation
EM890519 6P

Advances in powder coating materials along with the advances in application equipment have made premold coating of plastics an attractive alternative for plastic finishing. Topics discussed include features of premold coatings, application systems, mold mask design, electrostatic application equipment, molding compound selection, and finishing considerations.

What's Ahead for Prepaint-NCCAs look at the 90s
Moorman, Robert W.
The Glidden Company
EM900553 6P

This paper describes who the national coil coaters association is, what it is doing, and the benefits it brings to the marketplace. The paper then discusses the main business segments currently involving coil coatings including current business conditions and the outlook for each for the near-term future. The business segments discussed include building products, transportation, appliance, garage and entry doors, office furniture and equipment, and containers. The paper concludes with several factors that are driving various industries to the use of prepainted metal in these competitive times.

Pre-Painted Steel Versus Post-Painting
Frederick, Jerry
Overhead Door Corporation
EM900555 13P

This paper discusses the merits of pre-painting garage door panels instead of post-painting the product.

Preparing steel for painting is discussed as are embossing and roll forming and environmental factors.

The Use of Prepainted Metal in Manufacturing Steel Clad Residential Doors
Githens, Leslie J.
Consultant
EM900556 9P

When faced with the need to double production and unable to get EPA approval to expand an already overloaded spray painting operation, this company looked at several alternatives and modified their operation to use coil coated materials. This application was enthusiastically received in the marketplace and the company improved its "bottom line" performance while eliminating hazardous, time consuming, and costly operations.

Prepainted Flat Metal Coil Conversion Systems, A Case Study
Lehmann, Werner Karl Sesco, Inc.
EM900557 6P

This presentation describes the evolution of a case study pertaining to the reasons for selecting prepainted coil material in the fabrication of a major appliance manufacturer's new line of freezers. The manner in which the coated coil is delivered and how that material is accommodated by the machines which comprise the cut-to-length and stacking system is discussed.

New Electrostatic Application Equipment for Waterborne and High Solids Coatings
Scharfenberger, Jim
Ransburg-Gema, Incorporated
FC890169 18P

This paper will review the developments that have been made over the last 15 years in the area of electrostatic application equipment capable of applying conforming coatings such as waterborne and high solids. Also, an update is provided on recent developments in the area of automated finishing equipment, including applicators and modular controls, which provide the end user with improved process control and higher levels of automation.

Benefits of Titanium Nitride Coated Tube Forming Tooling
Teeter, Fred
Balzer's Tool Coating, Incorporated
FC890174 16P

The physical vapor deposition (PVD) titanium nitride (TIN) coating process has rapidly become an accepted cost-effective technique for extending tool life and improving part quality. Careful analysis of the substrate material and intended application is required prior to a coating decision. Good communications between the end user and the coater are required in order to assure that this analysis occurs. This paper reviews the coating process in general, surface preparation of the substrate prior to coating is critical for optimum results. Examples of coated tooling applications in the tube forming and fabricating industries are covered.

Prepainted Steel for the Fabricated Metal Industry
Venger, Irving B.
LTV Steel Company
FC890282 19P

Prepainted metal is gaining ever increasing acceptance as a cost effective alternative to painting manufactured products after assembly. The process promises improved coating performance, more uniform surface appearance, and freedom from environmental regulation, understanding the coating process and the fabrication capabilities of prepainted metals is the first step to eliminate painting from your operations.

An Induction Charging Scheme for Spraying Water-Borne Paints Electrostatically
Elmoursi, ALAA A.
General Motors Research Labs
Lee, Hsai-Yin
GM Advanced Engineering Staff
FC890603 13P

Water-Borne paints have significantly higher conductivity compared to solvent-based paints. As a result, they are unable to sustain the high potentials which are associated with existing electrostatic painting equipment. There is a current interest in using water-borne paints for their better appearance and their potential in reducing solvent emissions if they could be sprayed with higher efficiency than possible with purely mechanical means. The work describes an induction charging scheme which maintains the sprayer and the paint line at ground potential and applies the high-voltage potential to an external induction charging

electrode. The tendency for charged paint droplets to wrap back to the induction electrode was virtually eliminated by using a specially designed air shroud around the electrode.

Impact Plated Corrosion Protective Coating
Fuller, A. Dean
Germano, Victor V.
Metal Coatings International, Incorporated
FC890607 12P

Information is provided on a new, innovative coating process which is available in the U.S. and Canada through Metal Coatings International, Incorporated. Data on this patented technology includes details of the base coating process which applies a zinc-iron alloy. This coating results from "Impact Blasting" the metal substrate, particularly steel, with special zinc-iron alloy media in equipment similar to shot blasters. The zinc-iron alloy coated surface can then be passivated with a special chromate coating and/or with special topcoat paints. These coatings synergistically result in outstanding corrosion resistance for a wide variety of stamped, fabricated, forged or cast metal parts.

The Benefits of Elevated Temperature and/or Temperature Control of Higher Solids Coatings
Parmentar, William F.
Nordson Corporation
FC890610 16P

A brief discussion is presented of two specific applications where heating the coating material improved appearance and increased transfer efficiency. The basic equipment required for a heated circulating air atomized electrostatic spray system also is described.

Physical Properties of Powder Coatings as Performance Predictors
Bayley, Dennis A.
Valspar, Incorporated
FC890617 6P

Performance of powder coating during application and service can be predicted by carrying out a variety of physical tests on the powder and the cured film. These *performance parameters* include coverage, storage stability, fluidity, ability of powder to be attracted to a substrate, smoothness of finish, and resistance to environment, chemical attack and physical abuse.

Powder Coating--How We Got Started--Guidelines
McLellan, Donald E.
Mills Products, Incorporated
FC890623 8P

The factors leading to the decision to enter the powder coating business are reviewed. The various steps taken *in the planning, design, erection and start up of the* system are discussed. Also, presented are the guidelines of general interest to those contemplating a powder coating system.

E.L.P.O. and Powder Coat - New Paint Development and Implementations
Adams, James S.
General Motors Corporation
FC890624 14P

All major automotive suppliers endeavor to deliver products of the highest quality to their customers. In the area of finishing, the Inland-Fisher-Guide Division of General Motors and PPG have co-developed a unique high-gloss black finish for metal substrates which exhibits all the attributes required of a custom finish. This system is composed of a pigmented acrylic E.L.P.O. coated with an ultrasmooth clear acrylic powder coat. This paper addresses the parameters necessary to develop a new system, an evaluation of the advantages/disadvantages of the system and the facility requirements to implement the system.

Maximizing Control of the Paint Pretreatment Process
Pavesich, Anton R.
Chemical Systems, Incorporated
FC900225 13P

To get optimum performance from any paint pretreatment process, it is essential to control all three components of the process. These are pretreatment *chemical quality, the pretreatment process and final* painted part quality, this paper presents a concise method to manage all three critical components. A mechanism for checking vendor chemical quality is presented. A process control program for monitoring the pretreatment process is discussed. This will include an overview regarding the benefits of automatic controlling systems. Finally, a novel approach to testing and tracking final painted part quality is examined. The entire presentation is augmented by the

applicability of statistical process control in each of the three critical areas.

Upgrading an Existing Paint Line from Wet Top Coat to Powder Coat; Design Considerations
Nehls, Charles O.
Unistrut, Diversified Products Division
FC900226 14P

This paper relates to engineering, design, testing and installation considerations for the successful retro-fit of an existing paintline using powder coat. Mechanical, process, and testing criteria is offered, as well as housekeeping and existing equipment and facilities issues.

Process Support for Organic Coating
Collins, Bob
Metal Finishing Services, Incorporated
FC900333 7P

With the advent of high-solids solvent paint, water borne coating, electrocoating paint, and powder paint, the whole realm of pretreatment and curing of organic coatings has taken on a new meaning. This paper explores the total conveying system, pretreatment system, and curing system.

POWDER COATING BASICS
Kiefer, Steven L.
Morton International
FC900376 12P

The types, properties, and uses of currently available organic powder coatings are described. Also discussed are organic powder coating economics as well as advantages and disadvantages found when converting from liquid finishing to powder. Briefly described are powder coating formulating and manufacturing techniques.

Getting into the Fast Lane of Powder Coatings
Lapps, Drew
Nordson Corporation
FC900416 8P

Powder Coating Technology has emerged as the fastest growing finishing technology in recent years, and a growing number of manufacturing firms are considering the change over to powder coatings to address their product finishing needs. This paper describes the benefits, and explains the application process and critical factors that need to be addressed when converting to powder coatings.

Waterborne Automotive Finishes
Fox, C.B.
ICI Autocolor
FC900643 10P

The combined forces of environmental protection, consumerism, energy conservation, and productivity are completely altering the nature of coatings used by the automotive industry. Waterborne basecoats allow application of low-volume solids, thus producing optimum metallic effect while maintaining compliance with emission regulations. To control rheology and thereby sag resistance and metal flake orientation, a novel aqueous microgel polymer has been developed. Processing of these basecoats is similar to present solvent-borne finishes with the exception that stainless steel equipment must be used and water must be removed before application of clearcoat. The production feasibility of waterborne basecoats was first established in a Canadian truck assembly plant and in the next two years several other production facilities are expected to convert to this new technology.

Paint Film Laminate Technology for Painting Thermoplastics
Fridley, Charles H.
Avery, Automobile Division
FC900644 8P

The laminate painting process offers a production-ready method for painting thermoplastic parts without spray painting. This process provides a smooth, high gloss, painted surface without orange peel that meets automotive finish requirements and has exceptional resistance to chemical etching, solid colors, metallics, and graphic patterns can be produced. Because solvents are incinerated during paint laminate manufacturing, and the paint laminate is applied dry, the process generates extremely low VOC emissions. This paper describes how the paint laminate is manufactured, how it produces a painted part, and the advantages of the process.

Paint Film Laminate Technology for Painting Automotive Thermoplastics

Fridley, Charles H.
Avery--Automotive Division
FC900654 14P

Paint film laminate technology provides a method of painting automotive exterior thermoplastic parts without spray painting. High glamour, extremely smooth metallics, and solid colors can be produced. Graphic elements also can be incorporated into the finish. Paint via this technology is virtually pollution-free since the paint is in a dry form. This process consists of insert molding a paint film laminate that has been thermoformed into the shape of the finished part. The injection molded part is then ready for assembly without subsequent finishing.

Development of Corrosion Resistant Tinplate Di Cans with an Improved Conversion Coating Film
Hayashi, Nobuyuki
Toyo Seikan Kaisha, Limited
FC900779 12P

The exposure of the base steel of tinplate is known to be present on the outermost surface of di can bodies. Exposed iron causes early perforation or under film corrosion (UFC) as coexistent tin does not behave as a sacrificial anode to iron in coated cans. To reduce steel exposure and UFC, a surface treatment was developed, a kind of conversion coating of an extremely thin film of tin, phosphorus, and oxygen. To evaluate iron exposure of uncoated cans, a specially designed composite electrode was used.

What's New about Beverage End Coatings
Landauer, Lee
The Valspar Corporation
FC900783 8P

Beverage end coatings are changing to accommodate new customer needs in the areas of improved air quality, faster coil coating speeds, and a wider variety of beverage products. Three recent commercial coating innovations are discussed and measured against these driving forces for change. A look into the future indicates continuing opportunities for coating, equipment, and process innovation.

Organic Coating Systems for Two-Piece DWI and DRD Food Cans
Palackdharry, Peter J.
Wolters, Mark A.
Cole, Harold F.
Dexter Corporation
FC900789 11P

This paper deals with the development of organic coatings as film formers for the interior and exterior of two-piece DWI, DRD, and triple drawn food cans. It is now widely recognized by the food can industry that the two-piece can technology offers significant advantages in cost and packed product protection over the traditionally used three-piece containers. Coatings developed to meet the performance requirements for the interior of two-piece DWI cans include a combination of epoxy, acrylic, and an alkoxylated melamine in the U.S., coatings for DRD, DTR or triple-drawn cans are based either on vinyl organosols or epoxy which is appropriately compounded and crosslinked.

Innovations in Powder Coating Systems
Talbert, Rodger
Rapid Engineering, Incorporated
FC910141 9P

As limitations of powder coating are revealed, manufacturers have worked to overcome them and provide equipment and concepts that make powder coating easier for a larger number of applications. This paper focuses on innovative ideas on washers, ovens, conveyors, application equipment, and booths. Some of the problems facing the current or future powder coater are color change time, faraday cage effect, film build control, and defects. The equipment manufacturers have developed some improvements that can help deal with these problems.

Overview of Powder Application Equipment
Fooksman, Marc A.
Gema Volstatic Industrial Powder Systems
FC910142 16P

The most popular method of applying powder coatings is using the electrostatic process. The primary advantage of this process is the high material utilization due to the reusing of the overspray material. This paper reviews the overall electrostatic powder coating process focusing on the powder booth or recovery system. The type of recovery systems selected for a

particular application will depend on several factors. The features and benefits of the different types of collection systems available on the market today are presented. Included are conventional, filter belt, and cartridge systems. Also compared is the criteria for selection of a particular booth design and the differences between them.

Trends in OEM Coating Products
Hammond, Patrick A.
PPG Industries, Incorporated
FC910261 9P

Reviewing the driving forces of the past 10 years explains how current OEM coatings were developed. Looking at the present demands provides a good glimpse of the future. The push for better performance and a cleaner environment will drive the industry to new chemistries and the use of waterbase and powder coatings. These changes in coatings will require complimentary changes in process equipment to permit better control of booth temperature and humidity, higher transfer efficiencies, and precise control of baking temperatures.

High Purity IR Technology: A Finisher's Competitive Advantage
Leach, Curtis
Thermal Innovations Corporation
FC910368 9P

For the industrial finisher concerned with environmental compliance, productivity, and quality, infrared (IR) technology offers a viable alternative to conventional drying and curing processes. Many manufacturers have considered a conversion to water-based paints or powder coatings, materials that are more environmentally compatible. These products require a considerably longer time to dry or cure, which can be overcome by using an IR oven system. IR technology acts directly on the coating and cures it from the bottom up. The overall effects of this technology are to greatly reduce curing/drying time requirements, permitting faster line speeds, and to allow the manufacturer a high degree of process control. Furthermore, the rapid, controlled cure afforded by the IR process often leads to higher quality finishes.

Converting Solvent Bases Electrostatic Spray Systems to Waterborne
Hagood, David G.
Nordson Corporation
FC910369 8P

This paper explains how a solvent-based electrostatic spray system can be converted to waterborne. It will show how conversions have been done in the past and demonstrate new developments that allow the conversion to take place with a minimum of time and investment. Guidelines are presented to allow electrostatic spray system users to determine the best way to convert their solvent-based electrostatic spray system to a waterborne spray system.

Automotive Waterborne Paint Shop Conversions
Whitall, Kevin
Durr Industries, Incorporated
FC910370 12P

Waterborne paints require special consideration when used in automotive paint finishing systems. Existing system spraying high solids solvent based paints cannot be converted to waterborne without a substantial amount of modifications to the process equipment including spraybooths, paint applicators, and sludge systems. This paper describes the scope of the modifications to existing paint systems.

Autodepositon--The Environmental Advantage
Jones, Thomas C.
Parker + Anchem
FC910371 9P

Autodeposition utilizes aqueous dispersions of polymer, pigment, and activators to coat metal. The process eliminates the need for a conventional conversion coating. The coating bath operates at room temperature and is chemically, rather than electrically activated. Autodepositon has a high coating transfer efficiency, energy use efficiency and eliminates volatile organic compounds.

Direction in Jobshop Electrocoat Technology
McGee, John
BASF Corporation
FC910372 8P

In addition to providing high levels of corrosion protection, new cathodic electrocoat technologies offer economic, applicational and environmental advantages over conventional technology of five and 10 years ago.

In this paper, such advantages are demonstrated by comparing current cathodic electrocoat technology with preceding conventional technology.

Waterborne Coatings for Automotive Plastics
Pelo, Rodger
Zezinka, Liz
Senkfor, Howard
PPG Industries, Incorporated
FC910373 7P

The demand for waterborne coatings for plastics is being driven by the need to improve the automotive finishes and to reduce VOC. Waterborne basecoats are smoother overall and allow better aluminum orientation in metallic colors which allows assembly plants to produce cars with higher gloss and DOI. Waterborne basecoats have a lower VOC per gallon than solvent borne basecoats; however, lower paint solids and electrostatic application obstacles offset some of the VOC advantage.

In-Mold Painting of Thermoplastic Parts Using Paint Film Laminate Technology
Fridley, Charles H.
Avery Dennison--Automotive
FC910374 11P

Exterior Automotive Thermoplastic parts can be painted in the mold using paint film laminate technology. This is accomplished by insert molding of a vacuum thermoformed shell made from the paint film laminate. This process provides a smooth, high-gloss painted surface meeting automotive requirements and exhibiting exceptional resistance to chemical etching, solid colors, metallics, and graphic patterns can be produced. Since the paint film laminate is applied dry, the process generates no VOC emissions and does not require any painting facilities. This paper describes how the paint film laminate is manufactured, how it provides a painted part, advantages of the process, and commercial applications.

Flame Treatment of Polyolefin
Digiacomo, Joseph D.
Lindland, H. Thomas
Flynn Burner Corporation
FC910376 12P

Direct flame treatment of polyolefins offers significant advantages over other methods. Increased use of water-based inks has resulted in the need to utilize these advantages. Technological breakthroughs and innovations have helped in the development and design of flame treating stations that provide consistent and superior surface treatment. The Parameters affecting surface treatment are identified and their effect on surface treatment are discussed.

Painting TPO
Davis, Keri Krueger
Clark, Peter D.
BASF
FC910377 6P

Thermoplastic polyolefin (TPO) is used extensively in the automotive industry. Various methods have been used to improve paint adhesion properties. New adhesion promoter technologies offer significant improvements in solvent emissions and final product appearance. These adhesion promoters are designed to allow the use of various topcoat technologies. Waterborne basecoats offer the ultimate appearance with the lowest VOC.

Reclaiming Powder
Presutti, Mario
Weston, Ontario, Canada
FC910378 9P

This paper discusses powder coating booths in the powder coating process.

Architectural Powder Coatings--A Review of Current Technologies and a Discussion of New Advances in Exterior Durable Systems
Osmond, Matthew F.
Courtaulds Coatings (Holdings) Limited
FC910380 17P

Powder finishing of architectural aluminum now accounts for over 30% of architectural finishes in Europe. This paper introduces two areas of opportunity which offer significant potential for growth in the use of architectural powders, both in North America and worldwide. The latest developments of powder systems with significantly increased exterior durability are discussed. Emphasis is placed on the use of accelerated weathering as a means of assessing exterior durability, and comparative methods are

reviewed. A landmark in such development is to produce a powder that complies with the American Architectural Manufacturers' Association AAMA 605.2-90 performance standard. Alternative techniques for powder application to sheet products also are examined. In the siding and cladding market, flat bed application methods offer great potential for expansion in the use of architectural powder coatings.

Protective Thermoplastic Powder Coatings Specifically Designed Adhesive Polymers
Glass, Terry
Depoy, Jaddy
Dow Chemical Company
FC910384 18P
Properly designed and formulated thermoplastic powders applied in-tandem with suitable thermal spray, electrostatic, and fluidized bed equipment allows successful coating of small to large substrates/articles in the shop and the field. A variety of unique properties obtained with the use of Ethylene acrylic acid copolymers for these powder coating applications and the importance of proper formulation/stabilization and properly understood application parameters is included. The analytical methods used to determine when a coating is properly applied is also discussed.

Automated Application of Silicone Glass Like Coatings for Polycarbonate Headlamps Lenses
Mokerji, Subrata
Warchol, Frank
Scranton, Joe
Vacumet Incorporated
FC910386 10P

Silicone hardcoating and plastic headlamp lenses were first developed in the late 1970's due to the growing trend in automobile design towards weight reduction as well as a desire for design flexibility, General Electric's lexan polycarbonate coated with General Electric's advanced primer and silicone hardcoat combination qualified as a perfect replacement for glass automotive headlights. Vacumet Incorporated in conjunction with GE first developed the process engineering specifications for hardcoat applications on Ford aerodynamic headlamp lenses. Initially the lenses were hand-sprayed. As volume increased, and automated hardcoating of aerodynamic lenses using the W.S. Rockwell spray system was implemented.

Powder Coating Application and Recovery System
Turnipseede, James E., Jr.
Nordson Corporation
FC910433 18P

As powder coating continues to increase in popularity, the demand for powder systems has expanded. This paper qualifies what is necessary to select the proper application and recovery system. Special emphasis will be directed to the various types of equipment available and the proper sizing considerations for those components.

Thermoplastic Polyamide (Nylon 11) Coating Powder
Petersheim, Jerry
Atochem North America
FC910509 20P

Nylon Polyamide powders are thermoplastic coatings which are applied to metal components. They are used in a wide range of applications where demanding properties are required. This paper introduces the nylon 11 type of powder coating to those unfamiliar with it, and discuss coating techniques such as electrostatic spray, fluidized bed, minicoat, and flame spray. Also, examples of applications, limitations, and troubleshooting defects are reviewed.

Portable Thermoplastic Flamespray System
Heaney, William J.
Plastic Flamecoat Systems
FC910514 8P

A portable, flamecoat process has been developed. The process is environmentally safe and applies a single coat of thermoplastic resin using only propane and compressed air. The pinhole free coating has excellent adhesion plus chemical, weather and abrasion resistance. Flamespraying preheats and dries the surfaces as the coating is applied. Allowing application even under cold and damp conditions. The flamecoat process has demonstrated better durability than even high-performance paints. Thermoplastic resins are selected and processed to insure optimum performance. The improved coating performance and process advantages are obtained at a cost which is competitive with paint.

Co-mingling Paint Booth Sludge with Other Industrial Waste
Monken, Alan
Calgon Corporation

FC930391 7P

In light of pressures to continuously reduce plant-generated wastes,ways to reduce paint booth wastes are constantly being sought. One possible solution is the co-mingling of both paint booth wastes with more routine plant waste water, treating both in a common system. This paper explores the possibility of this approach and ways it can be utilized.

Global Review of Automotive Clear Coats: Today and in the Future
Salatin, Timothy D.
BASF Corporation
FC930392 11P

The area of clear coats for automotive OEM applications is experiencing great change. Performance criteria such as environmental etch resistance and emission reduction have given rise to new clear coat chemistries. However, the priorities of each region are not the same, which leads to variation in coatings technology. This creates a complex situation for coating suppliers, which are required to participate in the major world markets.

Effect of Cleaners on Metal Precipitation
Ghan, Josephine G.
Shah, Sadiq
Calgon-Vestal Laboratories
FC930393 15P

In the metal finishing industry, before the metal substrate is subjected to treatment such as phosphatizing, etc., it is cleaned with an acid or an alkaline cleaner. This presentation will discuss the role of the various components in the cleaning process, and address the metal precipitation issue as a function of the pH of water. An ideal cleaning product should, in addition to offering excellent cleaning performance, also offer a defined pH window for complete metal precipitation, and should readily biodegrade in the waste stream, and contain no components on the Sara 313 list.

Selecting and Installing a Water Based Paint System
Ritter, Clifton H.
Monroe Auto Equipment Company
FC930394 15P

The purpose of this case study was to describe the means by which one company was able to provide customers with a more durable finish on ride control product, provide a finishing system for the new aftermarket strut, and meet the state air permit requirements. This study reviews available finishes and equipment by which the company could best meet the demands of its customers, the new strut production, and the air permit requirements. Paint and equipment testing which helped Monroe optimize the design of the system is discussed.

Scratch and Mar of Automotive Clearcoats
Gregorovich, B.V.
McGonigal, P.J.
E.I. Dupont De Nemours
FC930395 12P

Scratch and mar performance has gained in increasing attention due to high visibility on clearcoats. We have compared a variety of clearcoats using laboratory tests and panels sent through a commercial carwash. Mechanical and tensile properties of coatings have been studied and compared to their mar behavior. Understanding how coatings respond to physical stress provides information on failure mechanisms.

Designing and Installing a Powder Coating System
Liberto, Nick
Powder Coating Consultants
FC930400 18P

When looking to purchase and install a powder coating system there is an agenda that has proven itself to be very helpful. This article will describe this "recipe of success" which as been developed in over 100 powder coating projects.

Selection Consideration Review for New and Revised Painting Facilities
Grear, Robert D.
Consultant
FC930401 9P

This paper gives you a macro look at some of the techniques that might be helpful to anyone considering major revisions or creation of a new finishing system. These are practical guides that experience has taught can help to focus on all the alternatives to be

considered. They are not motivated with pre-conceptions for any technology and should permit a systematic evaluation and elimination of alternatives in order to provide the best combined needs for your organization.

The Emerging Technology of Powder Recovery Systems
Bryan, Jr., G. Bruce
Gema-Volstatic
FC930403 15P

This paper will discuss the primary advantages and limitations of the two major powder recovery systems, cyclone and cartridge module. This paper includes a brief history of both technologies, but will focus on design criteria, color change capabilities, powder recovery efficiencies, and safety concerns. A brief economic comparison will be included.

Tribo or Corona? Here's How to Decide
Knobbe, Alan J.
Nordson Corportion
FC930404 13P

Powder Coating Systems have either triboelectric or corona charging powder spray guns which have been in use for many years coating a wide variety of parts. This paper reviews the differences in each type of spray gun. Finally, the paper conveys these differences to the strengths and weaknesses of each type of gun as they relate to the factors for selecting one type over the other for a new powder system.

How to Succeed in Custom Coating
Andro, William
Kentwood Powder Coating
FC930405 11P

In 1988, one company was established to provide a top quality powder finish to those manufacturers electing not to do their own finishing in the West Michigan Region. A review of the potential customer base determined the type of service that would be required. This dictated the type of equipment purchased and the company's operating strategy. Finally, practical hints on some financial aspects of custom coating will be reviewed to highlight areas that may be overlooked in cost estimating.

Small Companies Considering Powder Coating
Henderson, Dennis R.
Powder Systems Specialist
FC930406 13P

The intent of this paper is to enlighten the small manufacturer of the increasingly available systems design choices offered by equipment manufacturers across the country. The paper describes the four primary components that make up a powder coating system. Powder coating offers the user many options and advantages that, until recently, were not readily available.

Chip-Resistant Powder Coatings for Automotive Applications
Gilbert, John A.
BASF Corporation, Coatings & Colorants Division
F930407 24P

Polyester and Acrylic Powders are being used as primer surface and antichip materials in the automotive industry. Antichip coatings can be formulated for applications over "wet," or uncured, electrocoat or over cured electrocoat. They are applied to chip-prone areas such as doors, hoods, and rocker panels. Full body primer surfacers for application over partially cured or fully cured electrocoat have been developed as well. The advantages and disadvantages or different types of powder primer coatings are discussed.

Ovens
Talbert, Rodger
Rapid Engineering
MS900189 7P

This paper reviews ovens as used in powder coating. Types of ovens, heat sources, and oven containment are discussed. General specifications are also reviewed.

An Update of PVD Tin, and New Generation Coatings for Cutting and Forming Tools and Component Wear Parts
Vogel, J.
Balzers Limited
MS900366 5P

Ten years after the introduction of tin-coated twist drills by Guhring and Balzers, it is now time for a resume.

Many problems still remain for the tin-coatings. New coatings can only partially solve these problems.

PRETREATMENT

Chemical Cleaning and Finishing
Cubberly, Wiliam H.
Cubberly & Associates
Bakerjian, Ramon
Society of Manufacturing Engineers
B1419C46 PP 46-1 - 46-15

Cleaning is the process of removing objectionable matter from the surfaces of manufactured products. Drawing and stamping lubricants, cutting fluids, heat treatment scale and oxides, and fingerprints are typical of soils that must be removed. This chapter presents some metal cleaning processes used for various purposes.

Pretreatment for Powder Coatings
Dawson, Sam
Reddy, Vishu
Editor
B1664C03 First Edition PP
83-107

Maximizing the good qualities of powder coating requires effective pretreatment. Proper pretreatment enhances the powder coating finish. Cleaning, phosphatizing, rinsing, and other aspects of pretreatment are discussed. Three Papers.

Surface Preparation and Pretreatment in the Automated Finishing System
Marino, Frank P.
Inno-Coat, Division of DPP Systems, Incorporated
FC890172 13P

Proper pretreatment and surface preparation is an essential first step in the finishing process. In designing a pretreatment system, consideration must be given to the level of quality required, the production quantities that must be handled, and the acceptable levels of capital and operating costs. This paper reviews the chemistry and equipment required to pretreat both metal and plastic substrates for spray, electrocoating, or autodepositon and discusses how to configure an automated pretreatment system to ensure optimal finish quality by maintaining consistency in washer chemistry and cleaning processes.

Pretreatment Processes Considering the Use of Precoated Steel and Aluminum Alloys
Eriksson, Mats
CM Surface Treatment, Incorporated
FC890615 29P

The increased use of precoated steel and aluminum alloys in the metal working industry also increases the demands on the pretreatment processes used before painting. By treating assemblies made of different metals and alloys, the manganese/modified low zinc phosphate processes have proven outstanding quality. When using iron phosphate processes, in for example, the appliance industry, the organic accelerated processes provide a higher quality than the molybdate accelerated processes. The chromium-free sealant post rinses based on organic compounds, can provide good quality on steel and galvanized steel if a low zinc or manganese/modified, low zinc process is used.

Designing a State of the Art Pretreatment Machine
Collins, Bob
Murray Ohio Manufacturing Company
FC890616 6P

With the advances that have been made in organic coating materials, it is no longer good enough to simply "clean at" the substrate. Now we must be assured that the substrate preparations are as good as we can make them. We will take you through the process of designing, procuring, installing, and operating a state of the art cleaning and pretreatment machine.

QC/QA Field Application for Painted Parts
Reseland, John C.
Calgon Vestal Laboratories
FC890629 16P

ASTM Quality control specifications provide guidelines for the evaluation of finished goods as they relate to the marriage of pretreatment, top coating, and their subsequent synergistic performance. Often, these tests are not performed on a routine basis to assure quality finished goods. This paper explains these tests, their interrelationships, and the importance they have in the

manufacturing process. Also, it is a practical guide toward setting up a quality assurance program to allow users to document and control their operations for good manufacturing practices (GMPS). Specific tests discuss adhesion corrosion control. A discussion is presented of the tools needed, the documentation schedules, and how log sheets enhance the program and give a practical and easy format for the end user. The focus is on developing a practical easy-to-use "how-to" procedure of assuring that the manufactured goods will represent the highest quality possible.

Maximizing Control of the Paint Pretreatment Process
Pavesich, Anton R.
Chemical Systems, Incorporated •
FC900225 13P

To get optimum performance from any paint pretreatment process, it is essential to control all three components of the process. These are pretreatment chemical quality, the pretreatment process and final painted part quality. This paper presents a concise method to manage all three critical components. A mechanism for checking vendor chemical quality is presented. A process control program for monitoring the pretreatment process is discussed. This will include an overview regarding the benefits of automatic controlling systems. Finally, a novel approach to testing and tracking final painted part quality is examined. The entire presentation is augmented by the applicability of statistical process control in each of the three critical areas.

Ionizing Blow-Off Systems
Horn, Paul
Paul Horn and Associates, Incorporated
FC900676 20P

This paper discusses the use of ionizing air blow-off systems to reduce the high voltage charge from the surface of automotive plastic components prior to finishing and assembly. The latest state-of-the-art equipment that's available off the shelf and specially designed turn-key systems are investigated.

Total Process Management
Kordick, Charles J.
Chemical Systems, Incorporated
FC910362 8P

One of the many challenges faced by the finishing industry is the need to gain control of the pretreatment chemical process. This paper details the facets of a program designed to achieve this control. A successfully implemented total process management program has a positive impact upon the performance, environmental, and economic needs of the industry. The challenge of manufacturing demands such an approach to chemical pretreatment in the finishing industry.

Pretreatment Process Conversion: Zinc to Iron Phosphate
Boram, William A., II
Wayne Division of Dresser Industries
FC910363 7P

Faced with increasingly more stringent State and Federal regulations regarding hazardous waste disposal, industry has been persuaded to seek new alternatives. In regards to metal surface pretreatment, iron phosphate seems to be a better choice than zinc, which has been documented in the report. This paper reviews preliminary research, advantages/disadvantages and a step-by-step procedure detailing the actual conversion process.

Finishing: Where Do You Start? 1993
Tupper, George
Coral International Incorporated
FC930312 12P

An introduction and review of the pretreatment process together with a discussion of the factors that effect the durability and useful life of the ware produced. Included are comments concerning types of cleaners, cleaning processes and what affects their choice and performance. Conversion coatings, iron and zinc phosphates, chrome and non chrome treatments are discussed. The effect of proper post rinsing on accelerated and physical testing is reviewed and the merits of vendor meetings are noted.

COATING REMOVAL

Plastic Media Blasting: An Alternative for Coatings Removal
Abbott, Kenneth E.
Stripping Technologies, Incorporated

FC890620 7P

Plastic Media Blasting (PMB) is a revolutionary process for the rapid, economic and safe removal of primer, paint and other surface coatings from almost any product, without the use of toxic chemical strippers, burn-off systems, sandblasting, or hand or mechanical sanding.

Dri-Strip Paint Removal and Selective Coating Removal Technology for Plastic Substrates
Knight, David
The Challenge Group, Incorporated
Wick, Walter
Waltom Services, Incorporated
FC900652 20P

An economic and environmentally sound method of paint removal and defect repair has been developed for the automotive industry. The technology, known as dri-strip, is being deployed for use on a wide variety of substrates including plastics and composites. The technology permits variations from full stripping of coatings from the substrate, discrete removal of individual coats (i.e., clearcoat from basecoat), to scuff treatment of large complex surfaces. Additionally, paint masks, bucks, and carriers may be cleaned of paint overspray buildup using dri-strip methods. The plastic abrasive media utilized is completely recyclable.

Automation of Aircraft Paint Stripping
Sturdivant, Vernon R.
Southwest Research Institute
FC910264 12P

Paint must be removed from aircraft to allow detailed surface inspection, to perform repair operations, and to keep weight at acceptable levels after many coats of paint have been applied. Southwest Research Institute is presently constructing a robotic system for automatically removing paint from fighter aircraft for the United States Air Force. The process that is being used for paint removal is plastic media bead blasting. The bead blasting process together with the media recovery system, the media separation system, the media transport system, the robot blast pot, and the blast nozzles are described.

Paint Removal for the 90s
Drust, Bert E.
Maxi-Blast, Incorporated
FC910365 11P
Paint and coating removal using dry blast plastic media offers superior cleaning results for a variety of different applications. Products manufactured from lightweight plastics to heavy gage steel can be blast cleaned with plastic media with no surface abrasion. This new media blast process is much faster than hand cleaning or chemical stripping. Plastic media poses no hazardous waste problem and has been accepted by many industrial manufacturing firms as the answer to refinishing their products

PMB: Coating Removal Process of the 21st Century
Abbott, Kenneth E.
Stripping Technologies, Incorporated
MR890142 9P

Plastic Media Blasting (PMB) is a revolutionary method for the rapid and safe removal or primer, paint and even powder and chemically resistant coatings from almost all substrates without damage. Although resembling sandblasting, PMB does not use hard abrasives. Rather, the process employs soft, reusable plastic particles which are pneumatically applied at low pressures of 20 to 40 PSI. Since the plastic granules are harder than coatings but softer than underlying substrates, the PMB process can quickly remove coatings without harming substrates, including those that are easily damaged by sandblasting: aluminum, fiberglass, honeycomb, engineered plastics and advanced composites. When used on metal substrates, it does not pit, warp, stretch or remove metal. Additionally, the PMB process has major environmental rewards and can generate significant cost savings over other paint removal processes. Although relatively unknown in the private sector, the PMB process is being aggressively pursued by the military, particularly for the stripping of aircraft airframes and weapons systems.

Automatic Aircraft Paint Stripping
Sturdivant, Vernon R.
Southwest Research Institute
MS900280 10P

Paint must be removed from aircraft to allow detailed surface inspection, to perform repair operations and to keep weight at acceptable levels after many coats of paint have been applied. Southwest Research Institute is presently constructing a robotic system for

automatically removing paint from fighter aircraft for the United States Air Force. The process removes paint by plastic media bead blasting. The blast nozzles are positioned over the aircraft surface with a robot. The system consists of two, 9 degree-of-freedom (DOF) robots together with two robot controllers, one cell control computer, paint sensors, and bead blasting equipment.

Robotic Sensors for Aircraft Paint Stripping
Weniger, Richard J.
Southwest Research Institute
MS900282 10P

Aircraft of all types need to have paint routinely removed from their outer surfaces. Any method needs to be controlled to remove all the paint and not damage the surface of the aircraft. Human operators get bored with the monotonous task of stripping paint from an aircraft and thus do not control the process very well. This type of tedious operation lends itself to robotics. A robot that strips paint from aircraft needs to have feedback as to the state of the stripping process, its location in respect to the aircraft, and the availability of stripping material. This paper describes the sensors used on the paint stripping robot being developed for the United States Air Force's Manufacturing Technology program. Particular attention is given to the paint sensor which is the feedback element for determining the state of the stripping process.

APPLICATION EQUIPMENT

Coating Plastic Parts with Electrostatic Equipment
Chambers,Tim
Nordson Corporation
EM890188 12P

As the Environmental Protection Agency continues to mandate a cleaner atmosphere, more and more companies are eliminating in-house coating or are being forced to comply with these government regulations and to utilize a cleaner, safer process. One solution that satisfies this mandate is the electrostatic finishing process. This paper discusses electrostatic theory, types of plastics, hooks and hanging arrangements, prep coats, and application methods and equipment.

High-Volume/Low-Pressure (HVLP) Turbine Spray for Plastics
Bunnell, Michael H.
Can-Am Engineered Products
EM890517 13P

An overview of the turbine spray (HVLP) technology and how it works is presented. Working perspective of HVLP is discussed in comparison to high pressure style spraying systems. Because of environmental trends a section is devoted to applicability to the new high solids style coatings. Application emphasis is on how the attributes of turbine spray technology fit the needs of spraying plastic parts and specifically automotive style parts. The unique characteristics of this non-electrostatic system with a soft/gentle spray patter in relation to parts with recesses and cavities is discussed. Recent regulatory views on HVLP technology are also presented.

Spray Booth Basics
Tozier, David
Essex Specialty Products
FC890170 11P

Many areas of spray booth maintenance are overlooked when designing an automated paint line. The consequences can be very costly in terms of product quality (paint blemishes), increased maintenance frequency, and higher paint consumption rates. This paper addresses these problems from the point of view that a well-maintained paint spray booth is a prerequisite to consistent, satisfactory results. Areas discussed will include materials of construction, size, lighting, conveyor protection, air make up, air flow, overspray collection, and their relationship to improved finishes and cost effective spray booth preventative maintenance. This paper will help existing spray booth installations as well as those in the design state.

An Automated Coating Cell: Control Implementation
Mehta, Hemendra
Cimcorp, Incorporated
FC890429 7P

A case history is presented of an automated coating cell which includes the existing condition of the process, the automation decision, vendor selection, cimcell control system functions, system configuration, the automated manufacturing process, and critical success factors.

Powder Application Utilizing Tribo Charging Equipment
Dailidas, Jeffery
Nordson Corporation
FC890626 10P

The continuing growth of the powder coating market has led to many new advances in powder equipment and application methods. One of the methods of powder application that is growing in popularity is done with tribo charging powder spray guns. Tribo spray can offer the user many advantages, but is by no means the proper tool for every application. The intent of this paper is to discuss the differences between corona and tribo charging systems, provide guidelines when to choose tribo, and provide information on tribo application methods. Powders discussed throughout this paper will be thermosetting epoxies, acrylics, polyesters, urethanes, and hybrids.

Computer-Controlled Equipment for Two Component Materials
Shreves, Renee Davis
Binks Manufacturing
FC890628 7P

The finishing industry has long strived for that perfect finish that will not only protect, but is appealing to their customers. Today, high-performance catalyzed coatings are becoming increasingly more popular to achieve a long-lasting appearance. Equipment Manufacturers have successfully metered, mixed and dispensed two component paints for nearly 10 years. The Binks Ratio Control System is an example of state of the art in electronic control equipment utilizing positive displacement gear pumps. Some important advantages and disadvantages are emphasized as well as possible problems. In addition, this paper informs potential users of two component equipment of the many considerations to choose the proper equipment for a successful finishing system.

Advanced Flexible Abrasive Finishing Tools
Scheider, Alfred F.
Osborn Manufacturing/Jason, Incorporated
FC900153 18P

The content of this paper highlights new, recently developed flexible abrasive finishing tools used on robots, machine tools, manufacturing cells, NC and CNC machines, automated equipment, and special process systems. The flexible abrasive tools are the main link between the machine tool and the workpiece to be finished. The tools will radius, blend and contour edges, condition flat or irregular contoured external and internal surfaces. They will grind away burrs and unwanted material from precision parts made from aluminum, steel iron, stainless steels, titanium, super alloys, and some composites. Current production application data is presented covering the work performed with basic minerals and grain size of silicon carbides, alumina silicate, aluminum oxides, and the super abrasive polycrystalline diamond. Information for the selection of abrasives to provide the best performance on the various materials being finished or final finished machined in the integrated computer-controlled machine cycle.

Overview of Powder Application Equipment
Fooksman, Marc A.
Gema Volstatic Industrial
Powder Systems
FC910142 16P

The most popular method of applying powder coatings is using the electrostatic process. The primary advantage of this process is the high material utilization due to the reusing of the overspray material. This paper reviews the overall electrostatic powder coating process focusing on the powder booth or recovery system. The type of recovery systems selected for a particular application will depend on several factors. The features and benefits of the different types of collection systems available on the market today are presented. Included are conventional, filter belt, and cartridge systems. Also compared is the criteria for selection of a particular booth design and the differences between them.

Optimizing Recirculating Spray Washer Performance through Maintenance Programs
Monken, Alan
Calgon Vestal Laboratories
FC910364 8P

Even when the best chemical treatments are used, industrial recirculating spray washers can only be expected to perform at the level at which they are maintained. Proper maintenance procedures and schedules are necessary to keep recirculating systems operating as originally intended. In older systems,

refitting nozzles and spray headers may be in order, especially if production demands have changed over time. This paper examines different options for bringing recirculating washers back into efficient operation, improving production, and reducing operating costs.

Advances in Single and Dual Component Metering
Elberson, Michael D.
Schwamberger, Robin M.
Devilbiss Ransburg Industrial Liquid Systems
FC910366 18P

Two-Component Metering Technology is evolving. After many years of supplying the same type of metering or dispensing technology for two component painting materials, the equipment industry is supplying new innovative technologies for plural component paints. These technologies remedy many of the problems that existed with the pumping style metering equipment and offer the user greater versatility, performance, and reliability.

High Purity IR Technology: A Finisher's Competitive Advantage
Leach, Curtis
Thermal Innovations Corporation
FC910368 9P

For the industrial finisher concerned with environmental compliance, productivity, and quality, infrared (IR) technology offers a viable alternative to conventional drying and curing processes. Many manufacturers have considered a conversion to water-based paints or powder coatings, materials that are more environmentally compatible. These products require a considerably longer time to dry or cure, which can be overcome by using an IR oven system. IR technology acts directly on the coating and cures it from the bottom up. The overall effects of this technology are to greatly reduce curing/drying time requirements, permitting faster line speeds, and to allow the manufacturer a high degree of process control. Furthermore, the rapid, controlled cure afforded by the IR process often leads to higher quality finishes.

Powder Coating Application and Recovery System
Turnipseede, James E., Jr.
Nordson Corporation
FC910433 18P

As powder coating continues to increase in popularity, the demand for powder systems has expanded. This paper qualifies what is necessary to select the proper application and recovery system. Special emphasis will be directed to the various types of equipment available and the proper sizing considerations for those components.

Utilizing a Paint Sensor for Process Control for Paint Stripping
Weniger, Richard J.
Sturdivant, Vernon R.
Southwest Research Institute
MS890300 12P

Automation of aircraft paint-stripping is a key goal for the United States Air Force, other branches of the Department of Defense, and the commercial aviation industry. One major requirement for a successful robotic paint-stripping system is a method of adaptively controlling the process to compensate for differences in paint removal difficulty. By analyzing the spectral information from the stripping area, the percentage of paint remaining to be stripped from the aircraft can be determined. Based on the percentage of paint remaining in the stripping area, the velocity of the robot can be controlled, thus controlling the stripping effectiveness. This paper describes the operation of such a paint sensor and its application in adaptively controlling a paint stripping robot built for the United States Air Force manufacturing program.

A Strategy for Implementing Large Scale Robotic Painting and Cleaning Systems
Leek, Alan R.
Lynch, Mary
Vadeko International, Incorporated
MS890332 15P

Multiple and single cell systems using stand-alone robots designed for specific tasks (welding, painting, machine loading and assembly) have well-established methodologies for planning and implementation. Inevitably non-traditional users have begun to investigate the use of these robots for applications beyond their original intended use. With careful planning off-the-shelf robots can be incorporated into large scale systems for projects previously considered impractical. Despite the availability of major hardware, the successful implementation of large scale systems depends upon establishing a sound planning strategy

prior to a commitment to build.

CURING/DRYING

Curing and Conveyor Systems
Dawson, Sam
Reddy, Vishu
Editor
B1664C05 First Edition PP
149-168

Radiant/Convection and Forced Convection Curing ovens and infrared process heating are being used for curing powder coatings. A survey of types of conveyor systems provides a step-by-step layout guide for material handling. Four papers.

Haden Environmental Corportion Drypure Drying System
Page, Thomas A.
Johnson, Jeffrey C.
Haden Environmental Corporation
FC890601 7P

The generation of dry or nearly dry paint sludge has been an obviously good concept for many years. A major breakthrough was made in the application of a drying system to sticky sludges. The sludge is progressively heated to a high temperature, initially driving off all VOC and moisture, and then curing all residual paint resins in the sludge, as the temperature of the dried sludge is increased further, resins and other heavy organics normally considered solids in paints are volatilized and driven off as gaseous components. All off-gases from the system are collected and exhausted through either a condenser for recycling or a thermal incineration system for destruction.

The Use of Condensation Heating for Preheated Powder Coating and Plastisol Applications
Owens, J.G.
Olson, K.W
3M Company
FC890612 12P

Condensation heating is a heat transfer method used to preheat substrates and cure polymeric coating more efficiently in a controlled environment. The process involves heating a chemically inert and environmentally safe prefluorinated fluid to generate a saturated vapor zone having the same temperature as the boiling liquid. Latent and sensible heat are transferred to a cooler substrate introduced into the vapor zone as vapor condenses on all exposed surfaces of the product. This heat transfer method has the unique feature of providing rapid and uniform heating while maintaining precise temperature control. The advantages condensation heating provides for preheated plastisol and powder coating applications include shorter processing times, greater process control and improved uniformity of the finished product.

Measuring Cure/Bake Oven Effectiveness; A Computer Aided SPC Approach
McEvoy, Timothy J.
Datapaq, Incorporated
FC890651 12P

A bake oven, be it for coil, powder, plastic, automotive, extrusions or other complex parts, has but one purpose--to cure the coating on the substrate. How well the oven accomplishes this task has been the least measured, most avoided, segment of the manufacturing process as the oven environment is hot, often unpleasant, and easily gathered data seemed unattainable. Now, with advances in lightweight thermal protection and computer hardware and software, regular and appropriate monitoring can be done which assures that the manufacturer gets the most productivity out of the oven at the least cost--measured in reduced rejects, reduced energy costs, easier problem solving and greater control.

Paint Film Laminate Technology for Painting Thermoplastics
Fridley, Charles H.
Avery, Automobile Division
FC900644 8P

The laminate painting process offers a production-ready method for painting thermoplastic parts without spray painting. This process provides a smooth, high gloss, painted surface without orange peel that meets automotive finish requirements and has exceptional resistance to chemical etching. Solid colors, metallics, and graphic patterns can be produced. Because solvents are incinerated during paint laminate manufacturing and the paint laminate is applied dry, the process generates extremely low VOC emissions. This

paper describes how the paint laminate is manufactured, how it produces a painted part, and the advantages of the process.

Air Radiant Ovens for Curing Paint on Plastic Parts
Smith, Steven M.
Haden Schweitzer Corporation
FC900653 11P

Advanced technology in the use of automotive substrates creates new challenges for the paint finishing industry, primarily oven curing. This paper describes conventional oven curing systems and how they may be inadequate for certain plastics or vehicles which consist of differing substrates.

Improved Drying Technologies for Water-Based and Solvent-Based End Compounds and Coatings
Sprenger, Barbara
Morland, Robert
Mountaingate Engineering Incorporated
FC900782 14P

As the can-making industry moves toward the use of non-VOC producing compounds and coatings, a new drying technology is required for drying and curing of these sealants. Innovation in this area stopped when the industry moved away from water-based compounds in the 1940s, and is just beginning again. This paper discusses new dryers available for water-based seaming compounds, dryers which can catalytically burn the VOCs emitted from the most popular solvent-based compounds, induction drying and heating of can ends, and new dryers required for the repair coating process on easy open ends.

High Purity IR Technology: A Finisher's Competitive Advantage
Leach, Curtis
Thermal Innovations Corporation
FC910368 9P

For the industrial finisher concerned with environmental compliance, productivity, and quality, infrared (IR) technology offers a viable alternative to conventional drying and curing processes. Many manufacturers have considered a conversion to water-based paints or powder coatings, materials that are more environmentally compatible. These products require a considerably longer time to dry or cure, which can be overcome by using an IR oven system. IR technology acts directly on the coating and cures it from the bottom up. The overall effects of this technology are to greatly reduce curing/drying time requirements, permitting faster line speeds, and to allow the manufacturer a high degree of process control. Furthermore, the rapid, controlled cure afforded by the IR process often leads to higher quality finishes.

Convection Stabilized Radiant Heat Transfer Ovens
Hoecek, John B.
Thermal Engineering Corporation
FC920255 13P

Traditionally, ovens used in curing or drying coatings have fallen into one of two categories: radiant or convection. However, as developments in products, coatings, and manufacturing processes have progressed, the limits of each curing technology have become increasingly apparent. The use of combined radiant/convection ovens promises to help expand the use of thermally cured coatings by addressing the limitations of each technology separately applied. This paper presents both theoretical and practical aspects of radiant, convection, and combined radiant/convection ovens.

Critical Factors for Safe Introduction of Polyurethane Paint in an Automobile Assembly Plant
Norton, William Wesley
General Motors Corportion
FC950120 21 PP

Introduction of an isocyanate based polyurethane spray paint system into regular production was accomplished while maintaining control of workplace exposures. This case study presents an approach used to successfully identify, coordinate and implement control strategies.

High-Energy Dry Process Finishing
Davidson, David A.
Pegco Process Laboratories, Incorporated
MR900389 11P

This paper outlines and details several applications where the combination of high-energy finishing equipment and dry process media technology has improved surface finishes, reduced finishing costs dramatically, and ameliorated serious finishing effluent disposal problems.

SYSTEMS DESIGN

Photo-Electroforming: A New Manufacturing Process for Micro-Electro Mechanical Systems
Sachs, Emanuel
Tsao, Che-Chih
Massachusetts Institute of Technology
B2224637 First Edition PP
637-638

A process called "photo-electroforming" is introduced for the fabrication of Micro-Electro-Mechanical Systems (MEMS). The process defines geometry by depositing porous non conductive material and creating regions of selective conductivity using photo-thermally driven electroless plating. Electroplating or a second state electroless plating is then used to join the areas of selective conductivity to create an integral part. This process can create parts of high geometric complexity with a small number of steps.

Finishing of Reaction Injection Molded Plastics with Urethane In-Mold Coatings
Brown, Roger D.
The Glidden Company
EM920143 21P

The recent advances in the use of plastics in the automotive industry has provided incentive for coating manufacturers to look at new and innovative methods for painting plastics to provide decorative and protective finishes. One such method, in-mold coatings, has been shown to be a viable and effective process for painting polyurethane rim plastics. This paper discusses the process, coatings, and presents uses both in automotive and related industries. Costs and the prospects for the future of this technology are also discussed. A brief history of the development of in-mold coatings and the chemistry of the systems is presented as background.

A Unique Spray Coating Process to Create Corrosion Control Resistance Materials
Bristowe, William W.
Applied Polymer Systems, Incorporated
EM940116 16PP

A new cost effective plasma spray process and specially formulated corrosion resistant materials for use with the process have been developed. These materials consist of a wide variety of products based mostly on traditional polymers with the option of adding fillers or fibrous reinforcement. This newly developed plasma spray technology now permits substrates to be field sprayed with nominal heat input.

Noncontact Inspection of Surface Finish
Huynh, V.M.
University of Windsor
FC890343 14P

A noncontact measurement technique was developed to measure the surface finish of machined parts. The system uses machine vision system to capture the magnified image of a surface which is illuminated by a white light source at a shallow grazing angle. Grey-level histograms of the image were obtained to derive optical roughness parameters which could be related to the average roughness value RA measured by a profilometer. Calibration curves were obtained for different machining processes such as lapping, grinding, reaming, and turning with roughness values up to 500 micro-inch. This method provides a fast way of assessing surface roughness which can be adapted for use in industrial environments.

Dual-Voltage Electrostatic Coating System
Walberg, Arvid C.
Electrostatic Consultants Company
FC890367 8P

A new automatic electrostatic coating system will greatly improve transfer efficiency with an environmental coating containing 2.3 lbs/gal of volatile organic compounds (VOCS) or less to meet all environmental codes. The paint is atomized at much lower air pressure and is given a negative charge at the electrostatic spray gun. The product being coated is charged positive to provide maximum attraction. The "Faraday Cage" effect that prevents penetration into recessed areas is overcome and greatly reduces or eliminates manual touch-up. Quality of finish is improved while maintaining high production rates and high transfer efficiencies. VOCs can be reduced by up to 96% to meet all environmental requirements.

Coating Weight Determination of Metal Substrate Samples by FTIR

Beauchaine, John
Carol, Dr. Richard
Nicolet Instrument Corporation
FC890563 6P

This paper discusses coating weight determination utilizing a Fourier Transform Infrared (FTIR) System. An accurate and timely method of analyzing organic materials on metal substrates by utilizing specular reflectance and quantitative analysis software will be presented. Also presented is the profiling of a metal sample by micro-FTIR to determine homogeneity of a coating process.

Finishing: Where Do You Start?
Tupper, G. Lowell
Coral International
FC890572 7P

An introduction and review of the metal finishing process, this paper presents a look at chemical pretreatment including cleaning, cleaners, and what affects their choice and performance. Conversion coatings, iron and zinc phosphate, chrome or non-chrome treatments are discussed. The effect of proper post ringing on accelerated and physical testing is reviewed and the merits of vendor meetings are noted.

Innovative Automated System for Coating Large Steel Fabrication
Vezmar, Michael
Wallace Herdlein and Associates, Incorporated
FD890602 10P

Designing a paint finishing system to coat elements of storage systems (frames, beams, braces and small parts), while minimizing plant space requirements, was a challenging assignment. The beams, braces, and small parts were a natural for hanging vertically and using an electrostatic disc. The frames are wide, long, heavy fabricated structures with a lot of space around the support members and had to be handled on a totally separate line. The separation of the ware groups and the use of a power and free conveyor combined to result in an innovative design.

Purchasing an Automatic Paint System (Liquid)
Kost, John R.
Nordson Corporation
FC890605 14P

Before purchasing an engineered, automatic paint system, a buyer must accurately compile the specifications for particular needs because no two systems are alike. The different criteria that go into making up these systems must be analyzed very carefully, and this analysis must be done with the preferred vendor. Strong communications between buyer and vendor are a must, and this information gathering exercise should be viewed as one of the most important aspects of the whole project. Anything left out of the specifications at this point will usually be a stumbling block upon the installation of the system. Some criteria to be considered: viscosity and paint atomization characteristics, color change, and pumping system. Automatic paint systems can be very complicated and should be specified and designed with the utmost care to insure a good, reliable system.

Leading Edge Robotic Finishing Technologies
Dobson, Donald, CMfgE
GMF Robotics - West
FC890608 28P

During the past several years, advances in robotic finishing technologies have prompted virtually every major aerospace firm to investigate and implement the use of robots in their spray painting processes. These systems incorporate modern electric robots, environmentally controlled booths and advanced spray process control equipment. System complexity has ranged from simple stand-alone units to higher level integration with CAD/CAM off-line programming workstations and host computers. This paper concentrates on the numerous recent advances in robotic spray painting technology and how this technology is being applied in aerospace and military today. The author comments on future trends in robotic painting systems and some guidelines to use while developing a robotic painting specification.

A Distributed Systems Approach to Powder Finishing System Controls
Skelton, Cynthia A.
Nordson Corportion
FC890609 14P

The amount of electronic controls in powder coating systems sold in the United States is increasing yearly. This paper describes a system that is typical for highly automated systems. The system coats dryer tumblers and flatware at 30 feet per minute with no manual

touch-up. In order to automate the process, a PLC and two gunmovers are used. The electrostatic powder guns, the gunmover and the booth are controlled by the PLC.

Comparison of Recovery Systems
Fooksman, Marc A.
Ransburg-Gema, Incorporated
FC890613 16P

One of the most important components of a powder system is the recovery or collection of oversprayed powder. The high powder utilization typically found in a powder system is achieved only through an efficient means of reclaiming oversprayed material. The type of recovery system selected for a particular application will depend on quality of finish desired, color-change time, allowable floor space, batch size and number of colors. This paper discusses the features and benefits of the different types of collection systems available on the market today. Included are conventional, filter belt and cartridge systems. Also compared is the criteria for selection of a particular booth design and the differences between them.

Mobile Zone Designs: Environmentally Benevolent Surface Coating Process
Smith, Clyde
Smith Engineering
FC890614 20P

The mobile zone design is an environmentally sound redesign of a basic industrial production process--surface coating. The redesigned production process is inherently environmentally benevolent. These designs are virtually closed loop, improved spray booth designs for manned surface coating operations. The designs reduce capital and operating costs, increase production and reduce pollution, thereby saving time and money. These designs are characteristically simple, effective and inexpensive. Through these designs, industrial firms now have the opportunity to make significant progress toward the socially desirable goals of energy efficient and pollution free industry.

Automatic Closed Loop Fluid Flow Control
Lewis, Bill B.
Ransburg-Gema, Incorporated
FC890618 8P

The accuracy of an open loop flow control system is analyzed and evaluated with respect to a normal distribution of data. This data is used to demonstrate the potential for cost savings by converting to a closed loop control system.

Quality--Meeting Consumer Expectations
Dawson, Lee D.
Dawson Management Systems, Incorporated
FC890622 11P

Pleasing the customer is essential for continued success in the plastics coatings industry. To do this, a company must first define who the customer is and what he/she wants. By using simple techniques, such as team-oriented problem solving; cause and effect analysis, and the continuous improvement plan, it is possible to track progress and compare plans to customer expectations.

Powder Coating--How We Got Started--Guidelines
McLellan, Donald E.
Mills Products, Incorporated
FC890623 8P

The factors leading to the decision to enter the powder coating business are reviewed. The various steps taken in the planning, design, erection and start up of the system are discussed. Also, presented are the guidelines of general interest to those contemplating a powder coating system.

E.L.P.O. and Powder Coat--New Paint Development and Implementations
Adams, James S.
General Motors Corporation
FC890624 14P

All major automotive suppliers endeavor to deliver products of the highest quality to their customers. In the area of finishing, the Inland-Fisher-Guide Division of General Motors and PPG have co-developed a unique high-gloss black finish for metal substrates which exhibits all the attributes required of a custom finish. This system is composed of a pigmented acrylic E.L.P.O. coated with an ultrasmooth clear acrylic powder coat. This paper addresses the parameters necessary to develop a new system, an evaluation of the advantages/disadvantages of the system and the facility requirements to implement the system.

Conversion to Powder Coating Case Study: American Yard Products
Yeboah, Isaac
American Yard Products, Incorporated
FC890627 11P

Converting to powder coating from liquid paint has helped solve a lot of environmental, quality and cost methods of the finishing process at American Yard Products. Furthermore, it gave us the flexibility needed to meet today's high cost of finishing.

QC/QA Field Application for Painted Parts
Reseland, John C.
Calgon Vestal Laboratories
FC890629 16P

ASTM quality control specifications provide guidelines for the evaluation of finished goods as they relate to the marriage of pretreatment, top coating, and their subsequent synergistic performance. Often, these tests are not performed on a routine basis to assure quality finished goods. This paper explains these tests, their interrelationships, and the importance they have in the manufacturing process. Also, it is a practical guide toward setting up a quality assurance program to allow users to document and control their operations for good manufacturing practices (GMPS). Specific tests discuss adhesion corrosion control. A discussion is presented of the tools needed, the documentation schedules, and how log sheets enhance the program and give a practical and easy format for the end user. The focus is on developing a practical easy-to-use "How-to" procedure of assuring that the manufactured goods will represent the highest quality possible.

Upgrading an Existing Paint Line from Wet Top Coat to Powder Coat; Design Considerations
Nehls, Charles O.
Unistrut, Diversified Products Division
FC900226 14P

This paper relates to engineering, design, testing and installation considerations for the successful retro-fit of an existing paintline using powder coat. Mechanical, process, and testing criteria is offered, as well as housekeeping and existing equipment and facilities issues.

Improving your Paint Finishing System for the 90s
Schwamberger, Rob
Devilbiss
FC900227 11P

This paper discusses options for improving your paint finishing system. It provides an overview of alternatives for automating a finishing system. Electrostatic applicators, hard automation and flexible automation are discussed. Possible sources of V.O.C. reduction also are examined.

Closed Loop Control--Alternatives for Monitoring
Malover, Raymond J.
Precise Finishing Systems, Incorporated
FC900228 18P

This paper looks at the merits of open, monitored and closed-loop automatic spray systems, with special emphasis on the flow meter. It also provides a comparison of the two flow meters currently on the market for use in automated painting operations.

Paint Spray Optimization Using Intelligent Sensing and Control
Ettinger, Gary
Christian, Donald J.
FMC Corporate Technology Center
FC900375 12P

This paper is a case history of a spray paint optimization system based on intelligent sensing technology in a factory automation application. The system is implemented as a machine vision control for a reciprocating electrostatic sprayer used for priming and painting of armor plate for military ground vehicles. A laser imager digitizes visual cross sections of each plate one line at a time. The raster lines are then assembled into a two-dimensional image and processed. The spray pattern is optimized for precise paint coverage with minimum overspray. The paint optimizer system has yielded a measured 25% savings in bulk paint use, resulting in less booth and equipment maintenance, reduced paint fumes in the atmosphere and reduced waste disposal.

Electrocoating Systems--Application and Design
Case, Leo L.
Elcoat Systems, Incorporated
FC900560 25P

Electrocoating is filling an ever-increasing nitch in the organic finishing market. This paper reviews the basic fundamentals of electrocoating, the current and new application of this technology, plus a review of the

major mechanical and electrical components necessary to install an easily operated and maintained system.

Finishing Support Processes
Collins, Bob
Metal Finishing Services, Incorporated
FC900561 7P

An organic coating system is much more than a paint booth. This paper discusses the conveyor system, the cleaning and pretreatment system, and the curing or baking system, that are necessary to complete the "total finishing system."

Integration of Environmental Controls into Paint Shop Design
Paler, Douglas J.
ABB - FLAKT
FC900562 24P

The various types of environmental control options, and making them an integral part of the process, as opposed to an "add on" that contributes nothing to the process are reviewed. This paper centers around the paint cure system and integration into the booth, treating the booth and oven as one system and not two separate components.

Integration of Appropriate Conveyor Systems into Paint Finishing Systems
Macomber, Robert A.
Socio Tec Integrators, Incorporated
FC900563 11P

Quality competent engineering solutions are difficult to appreciate in material handling systems. Integrated solutions are a combination of mechanical equipment, functional controls, relationship with the industrial finishing equipment, the operational people and possibly with a reporting system. A quality material handling system is accomplished by combining the appropriate system type with correct components assembled properly into a system responsive to both the finishing equipment requirements and the user's overall manufacturing philosophy. The subject discussed in this paper defines the material handling solutions available to be applied to integrated industrial finishing (paint) systems.

Market Study of Paint Spray Booth Solvent Emission Control Systems
Kenson, Robert E.
Met Pro Corporation
Fernbach, Howard
Smithland Environmental
FC900631 14P

A market study evaluated the growth of this VOC emission control market segment. Study parameters were air flow volume-controlled, type of equipment produced, installation location, and industry sector. This paper summarizes this study begun 10 years ago when this market segment was in its infancy. Trends in market size, type of system selections by customers, industry sector where controls have been implemented, and geographic distribution of systems installed are discussed. Each type of system is discussed in terms of system flow schematic advantages, disadvantages, and economic analysis of a specific installation. There are now 45 installations of paint spraybooth solvent emission controls nationwide. Combined they control over 3,600,000 CFM of paint booth solvent emission loaded air.

Water Wash Spray Booth Design and Considerations
Hauck, Robert A.
Binks Manufacturing Company
FC900632 8P

Wet or Dry? Choosing the correct type of paint spray booth can avoid unnecessary finishing problems and possible financial hardships. Knowing the differences between the two types of technologies will help decide which type of booth is right for the job. This paper evaluates the major advantages and limitations of operating each kind of system. Special emphasis is placed on the advantages of water wash spray booths and how they operate. This report also examines some of the maintenance procedures required for proper spray booth operation.

Designing Environmental Compliance into a World Class Finishing Operation
Grear, Robert D.
Navistar International Transportation Corporation
FC900634 7P

This paper provides insight into how Navistar created and implemented highly innovative compliance technology for air and water at new truck finishing lines. Highlighted are a case study of the development of robotic application, recirculated-air paint booths, and

thermal incineration into a new standard for controlling emissions of liquid coatings operations. Having created the technology, it was also necessary to develop a protocol for testing and certification of something never accomplished before. A dramatic reduction of pollution has been achieved while providing a world class manufacturing operation for finishing.

Retrofitting Yesterday's Paint Spray Booth for Today's Detackification Systems
Monken, Alan
Calgon Vestal Laboratories
FC900637 9P

Many older paint spray booths which are still in service were not designed to work efficiently with the types of detackifying chemicals currently in use. With the advent of new paint types and higher solids levels, these new detackifiers are becoming the rule in many booths, including older models. Rather than scrapping all old booths, however, it is possible to easily and inexpensively retrofit systems to operate safely and efficiently. This paper presents several options and means to modify older booths for efficient chemical use and sludge removal.

Designing a Statistical Process Control Program for Paint Spray Booth Water Management
Shields, Grace
Kratz, Karl
Calgon Corporation
FC900638 10P

This paper describes the implementation program utilized by one company for the use of statistical process control (SPC) in paint spraybooth systems. The manner in which SPC is applied is quite different from that prevalent in industry today. This company plans to utilize SPC practices to maintain control over a process which determines the quality of water in the paint spray booth system. This paper provides detail on accomplishing the task of implementing SPC controls on the process of maintaining water quality. This is the chemical detackification and solids removal program.

Planning and Implementing Statistical Process Controls on a Powder Paint Line for Aluminum Alloy Wheels
Del Rivero, Gustavo
Rosales, Oscar
American Racing Equipment
FC900646 27P

This paper outlines the planning and implementation of SPC on a powder paint line. The paper relates the actual process implemented at American Racing Equipment. The discussion describes the planning, implementation, monitoring, tools and equipment, personnel training, and performance evaluation of a successful SPC program. Eight SPC characteristics are discussed along with the Deming management philosophy that has made the SPC program a success.

Ionizing Blow-Off Systems
Horn, Paul
Paul Horn and Associates, Incorporated
FC900676 20P

This paper discusses the use of ionizing air blow-off systems to reduce the high voltage charge from the surface of automotive plastic components prior to finishing and assembly. The latest state-of-the-art equipment that's available off the shelf and specially designed turn-key systems are investigated.

Tooling Cost Containment
Buttrey, Donald P.
Dayton Progress
FC900781 8P

This paper addresses tool life including: Material selection (carbide, ceramic, CPM); controlled heat treatment quality assurance; coatings and surface treatments; increased clearance; quality control and other methods (polish, vertical grinds, etc.). Assessing tooling costs is also discussed.

Innovations in Powder Coating Systems
Talbert, Rodger
Rapid Engineering, Incorporated
FC910141 9P

As limitations of powder coating are revealed, manufacturers have worked to overcome them and provide equipment and concepts that make powder coating easier for a larger number of applications. This paper focuses on innovative ideas on washers, ovens, conveyors, application equipment, and booths. Some of the problems facing the current or future powder

coater are color change time, faraday cage effect, film build control, and defects. The equipment manufacturers have developed some improvements that can help deal with these problems.

Planning for Automation
Taub, Larry
Texas Instruments
FC910262 26P

A step-by-step discussion of the factors to be considered when planning to automate a paint process. The following factors are addressed: production requirements, analysis of part arrays, process evaluations, quality considerations, equipment justification, and environmental considerations.

Painting Large Assemblies on a JIT Basis
Plunkett, Brian L.
John Deere Harvester Works
FC910263 8P

The availability of a newly developed high-gloss, low-temperature, E-Coat paint material permitted John Deere Harvester to rethink how it paints its product. The paint operation is now accomplished in the latter phases of the assembly process as compared to painting parts and/or small subassemblies. To provide a product with much improved paint durability and weatherability, the most visible, exposed exterior surfaces are robotically sprayed with a plural component urethane paint. This paper presents the technical and operational considerations of painting large complex assemblies and the resultant benefits.

Automation of Aircraft Paint Stripping
Sturdivant, Vernon R.
Southwest Research Institute
FC910264 12P

Paint must be removed from aircraft to allow detailed surface inspection, to perform repair operations, and to keep weight at acceptable levels after many coats of paint have been applied. Southwest Research Institute is presently constructing a robotic system for automatically removing paint from fighter aircraft for the United States Air Force. The process that is being used for paint removal is plastic media bead blasting. The bead blasting process together with the media recovery system, the media separation system, the media transport system, the robot blast pot, and the blast nozzles are described.

The Systems Approach to Lubricating and Maintaining Finishing Line Conveyor Equipment and Reducing Product Contamination
Brautigam, Dale P.
Lubecon Maintenance Systems, Incorporated
FC910367 10P

The major considerations to assure smooth, continuous operation of finishing line conveyors and to reduce product contamination are: the type and effectiveness of the lubricant used; the type of equipment used to precisely apply the lubricant to the wear points on a consistent basis; conveyor chain, trolley, and rail cleaning equipment; and a service program that will assure continuity of operation and maximum uptime at the lowest possible cost. The selection of lubricants, automatic lubrication equipment, and cleaning equipment for a variety of conveyors and other material transfer equipment that are used in the product finishing process are presented. The development and implementation of an effective maintenance program along with some methods to monitor the effectiveness of the program is discussed. The proposed systems approach, properly applied, will result in savings by reducing wear, parts replacement, power consumption costs, and conveyor downtime.

Application of Thermoplastics and Highly Filled Systems using a Modified Plasma Spray Process
Sweet, Gary K.
Applied Polymer Systems, Incorporated
FC920137 14P

A new cost-effective plasma spray process and specially formulated materials for use with the process have been developed. These materials consist of a wide variety of products based mostly on thermoplastic polymers with the option of adding fillers or fibrous reinforcement. Such thermoplastics include nylons, fluoropolymers and copolymers, polypropylene, and polyethylene, including ultra-high molecular weight, and high-density polyethylene (UHMWPE), to name a few. Fillers can be included to enhance abrasion resistance, fire retardancy, electromagnetic radiation absorption, as well as slip properties. These materials can be sprayed on vessels, structures, and various parts for in-house use or on-site treatment. Previously, these materials have been limited to the following processing methods:

electrostatic spraying followed by an oven baking operation, and a flame spraying, or hot-dipping, followed by an oven-fusing process.

Compliance Options for Auto Assembly Paint Operations
Hussey, Frank
Durr Industries, Incorporated
FC930172 15P

The potential impact of the 1990 Clean Air Act on the painting operations in automotive assembly plants was studied in detail. Various options were evaluated as to their cost-effectiveness in meeting future regulations. Anticipated VOC emission limits can be achieved by installing abatement equipment. New coatings or application techniques can be installed to achieve the same limits. Abatement systems were found to be more cost-effective than alternate coatings technologies. Overall, a combination of add-on controls and solvent substitution was found to be the most cost-effective approach to meeting emission standards that go into effect in the 1990s.

Advances in IR/Convection Curing Technologies
Leach, Curtis
Thermal Innovations Corporation
FC930399 14P

Infrared-enhanced convection curing technologies combine the seemingly contradictory infrared and convection energy transfer methods to produce high-quality industrial finishes in significantly less time than is required for either method alone. Using such systems requires an understanding of infrared and convection technologies and how they can be combined in a single curing system. This paper presents the elements of infrared and convection energy transfer and discusses their application in an IR-enhanced convection system.

Buying Decisions for a Finishing Line
Dawson, Samuel O.
Nordson Corporation
FC930402 24P

This paper will cover all factors that should be considered when purchasing a new finishing line or upgrading an existing line. Should you consider a turnkey installation, what are the advantages and disadvantages, the cost? The additional and often hidden costs are also covered. What the guarantee, penalty clauses, and the fine print in terms and conditions really mean and how to rate the value versus the price in the system you purchase.

Understanding the Chemical Treatment of Solvent Paints and Extrapolations to Waterborne Coatings
Mitchell, D.B.
Deboo, S.M.
Tonn, G.A.
Grace Dearborn
FC930409 25P

The introduction of waterborne paints has increased concerns about their treatment. This may be consequence of both rumors surrounding waterborne coatings, together with past negative experiences in treating solvent paints. This paper discusses omissions in the understanding of solvent paint systems and why simple extrapolations to treat waterborne coatings would be unadvisable.

Electroless Nickel: The Right Callout for Superior Corrosion and Wear Resistance
Weamer, Kurt R.
Imagineering Enterprises, Incorporated
McGarian, Thurman
MacDermid, Incorporated
FC940159 7PP

Electroless nickel coatings are versatile, highly controllable systems for the protection of metal components from wear and corrosion. This presentation will provide information concerning basic chemistry, physical properties and endline applications for the automotive industry.

Facility for the Automatic Spray Painting of Structural Elements
Duggins, Benjamin D.
Goolsby, Tommy D.
Benham, Robert A.
Sandia National Laboratories
MS890135 8P

A process has been developed for remote controlled spray painting of structures of various sizes and shapes with a coating of sensitive explosive. The damaging effects of a hostile nuclear burst are simulated when the explosive layer is detonated. The process has

evolved from a cumbersome, motor driven carriage assembly, to a facility which employs robotics and automatic positioning hardware. This paper describes the hardware components which have been introduced into the facility and the software which controls the spray application. The proper use of this hardware/software combination allows the design in advance of operations which deposit uniform or contoured thickness coatings onto complex shapes.

Experience with a Rail Car Painting System for CN Rail
Bishop, William B.
Vadeko International Incorporated
MS890151 12P

Over the past three years, Vadeko International has been the prime contractor in a program to robotically paint covered hopper cars for Canadian National Railways at their main repair and overhaul shops at Transcona, Winnipeg, Canada. This paper addresses Vadeko's experience in off-line programmed, robotic painting technology, in this system--the largest of its type ever built.

A Strategy for Implementing Large Scale Robotic Painting and Cleaning Systems
Leek, Alan R
Lynch, Mary
Vadeko International, Incorporated
MS890332 15P

Multiple and single cell systems using stand-alone robots designed for specific tasks (welding, painting, machine loading and assembly) have begun to investigate the use of these robots for applications beyond their original intended use. With careful planning off-the-shelf robots can be incorporated into large scale systems for projects previously considered impractical. Despite the availability of major hardware the successful implementation of large scale systems depends upon establishing sound planning strategy prior to a commitment to build.

Automatic Aircraft Paint Stripping
Sturdivant, Vernon R.
Southwest Research Institute
MS900280 10P

Paint must be removed from aircraft to allow detailed surface inspection, to perform repair operations, and to keep weight at acceptable levels after many coats of paint have been applied. Southwest Research Institute is presently constructing a robotic system for automatically removing paint from fighter aircraft for the United States Air Force. The process removes paint by plastic media bead blasting. The blast nozzles are positioned over the aircraft surface with a robot. The system consists of two, 9 degree-of-freedom (DOF) robots together with two robot controllers, one cell control computer, paint sensors, and bead blasting equipment.

Robotic Sensors for Aircraft Paint Stripping
Weniger, Richard J.
Southwest Research Institute
MS900282 10P

Aircraft of all types need to have paint routinely removed from their outer surfaces. Any method needs to be controlled to remove all the paint and not damage the surface of the aircraft. Human operators get bored with the monotonous task of stripping paint from an aircraft and thus do not control the process very well. This type of tedious operation lends itself to robotics. A robot that strips paint from aircraft needs to have feedback as to the state of the stripping process, its location in respect to the aircraft, and the availability of stripping material. This paper describes the sensors used on the paint stripping robot being developed for the United States Air Force's manufacturing technology program. Particular attention is given to the paint sensor which is the feedback element for determining the state of the stripping process.

Automatic CAD-Based Off-Line Programming of a Glaze Spraying Robot
Bidanda, Bopaya
Rubinovitz, Jacob
Technion, Israel
Narayanan, Vivek
University of Pittsburgh
MS910335 9P

The development of a CAD-Based off-line programming system for robotic spray-glazing applications is described. This system can lead to productivity increase, quality improvement, and material savings in the spray glazing process, while reducing job monotony and meeting environmental and health requirements.

The system algorithms access a geometric model of parts in a CAD system. Using the parameters of the spray-glazing process, it generates the robotic spray gun path. Path planning results are verified using graphic simulation software. An interface for downloading the resulting robot program to the spray glazing robot controller will also be developed.

RDBMSS vs. ODBMSS for Product Information Management Systems
McHenry, Stephen
Software Institute
MS930270 18P

This paper compares capabilities found in relational database management systems with those found in object-oriented database management systems for those contemplating implementation or selection of a product information system in the near future.

INSPECTION/QUALITY

Quality Control and Testing of Powder Coatings
Dawson, Sam
Reddy, Vishu
Editor
B1664C06 First Edition PP 169-186

Tests used with solvent-based coatings are not usually relevant to solventless powder coating systems. Sophisticated equipment is available which can assess the behavior of powder coatings. The quality connection between supplier and applicator is essential to successful powder coating. Two papers.

Coating Plastic Parts with Electrostatic Equipment
Chambers, Tim
Nordson Corporation
EM890188 12P

As the environmental protection agency continues to mandate a cleaner atmosphere, more and more companies are eliminating in-house coating or are being forced to comply with these government regulations and to utilize a cleaner, safer process. One solution that satisfies this mandate is the electrostatic finishing process. This paper discusses electrostatic theory, types of plastics, hooks and hanging arrangements, prep coats, and application methods and equipment.

High-Volume/Low-Pressure (HVLP) Turbine Spray for Plastics
Bunnell, Michael H.
CAN-AM Engineered Products
EM890517 13P

An overview of the turbine spray (HVLP) technology and how it works is presented. Working perspective of HVLP is discussed in comparison to high pressure style spraying systems. Because of environmental trends a section is devoted to applicability to the new high solids style coatings. Application emphasis is on how the attributes of turbine spray technology fit the needs of spraying plastic parts and specifically automotive style parts. The unique characteristics of this non-electrostatic system with a soft/gentle spray pattern in relation to parts with recesses and cavities is discussed. Recent regulatory views on HVLP technology are also presented.

New Concepts for Premold Powder Coating of Compression Molded Plastic
Duda, Edward J.
Corcoran, Everard B.
Ferro Corporation
EM890519 6P

Advances in powder coating materials along with the advances in application equipment have made premold coatings of plastics an attractive alterative for plastic finishing. Topics discussed include features of premold coatings, application systems, mold mask design, electrostatic application equipment, molding compound selection, and finishing considerations.

VOC Ramifications for Coatings for Plastic Substrates
Koreck, Joseph C.
Morton Specialty Chemicals Group
EM890520 17P

The state of the art in coatings for plastics is discussed in light of Michigan Department of Natural Resources Rule 632. The ramifications of governmental restrictions both on coating VOC content together with required equipment modifications will impact the plastic coating industry in 1991. The presentation highlights problem areas for compliance to the rule.

Support of Composite Fuel Cells
Westerman, E.A. (Bud)
Boeing Defense & Space Group
EM920101 8P

Aircraft structures designed with composite materials present a host of new problems for the maintenance community. Inspection and repair of composites with integrated lightning protection will challenge the inventiveness of design and support engineers. Repair of highly loaded composite fuel tanks presents a similar challenge. This paper discusses methods to replate electrically conductive surfaces used for lightning protection and safely cure a hot bonded repair in a potentially explosive environment.

Noncontact Inspection of Surface Finish
Huynh, V.M.
University of Windsor
FC890343 14P

A noncontact measurement technique was developed to measure the surface finish of machined parts. The system uses a machine vision system to capture the magnified image of a surface which is illuminated by a white light source at a shallow grazing angle. Grey-level histograms of the image were obtained to derive optical roughness parameters which could be related to the average roughness value RA measured by a profilometer. Calibration curves were obtained for different machining processes such as lapping, grinding, reaming, and turning with roughness values up to 500 micro-inch. This method provides a fast way of assessing surface roughness which can be adapted for use in industrial environments.

Haden Environmental Corporation Drypure Drying System
Page, Thomas A.
Johnson, Jeffrey C.
Haden Environmental Corporation
FC890601 7P

The generation of dry or nearly dry paint sludge has been an obviously good concept for many years. A major breakthrough was made in the application of a drying system to sticky sludges. The sludge is progressively heated to a high temperature, initially driving off all VOC and moisture, and then curing all residual paint resins in the sludge. As the temperature of the dried sludge is increased further, resins and other heavy organics normally considered solids in paints are volatilized and driven off as gaseous components. All off-gases from the system are collected and exhausted through either a condenser for recycling or a thermal incineration system for destruction.

Volatile Organic Compound (VOC) Emission Reduction Implementation
Brantley, Michael, CMfgE
E-Z-Go, Division of Textron
FC890611 17P

Federal regulations now mandate the quantity of VOC emission allowed by industry. As time passes, these standards are becoming more stringent. There are many ways that industries can choose to address this problem. Each method has advantages and limitations. This presentation will address the pros and cons of the following: increased transfer efficiency; waterborne coatings; high-solids coatings; powder coatings; autodepositon; electrodeposition, and incineration.

Comparison of Recovery Systems
Fooksman, Marc A.
Ransburg-Gema Incorporated
FC890613 16P

One of the most important components of a powder system is the recovery or collection of oversprayed powder. The high powder utilization typically found in a powder system is achieved only through an efficient means of reclaiming oversprayed material. The type of recovery system selected for a particular application will depend on quality of finish desired, color-change time, allowable floor space, batch size and number of colors. This paper discusses the features and benefits of the different types of collection systems available on the market today. Included are conventional, filter belt and cartridge systems. Also compared is the criteria for selection of a particular booth design and the differences between them.

Mobile Zone Designs: Environmentally Benevolent Surface Coating Process
Smith, Clyde
Smith Engineering
FC890614 20P

The mobile zone design is an environmentally sound redesign of a basic industrial production process--

surface coating. The redesigned production process is inherently environmentally benevolent. These designs are virtually closed loop, improved spray booth designs for manned surface coating operations. The designs reduce capital and operating costs, increase production and reduce pollution, thereby saving time and money. These designs are characteristically simple, effective and inexpensive. Through these designs, industrial firms now have the opportunity to make significant progress toward the socially desirable goals of energy efficient and pollution free industry.

Quality--Meeting Consumer Expectations
Dawson, Lee D.
Dawson Management Systems, Incorporated
FC890622 11P

Pleasing the customer is essential for continued success in the plastics coatings industry. To do this, a company must first define who the customer is and what he/she wants. By using simple techniques, such as team-oriented problem solving; cause and effect analysis, and the continuous improvement plan, it is possible to track progress and compare plans to customer expectations.

1,1,1-Trichloroethane a Viable Coatings Option
Mertens, James A.
Dow Chemical U.S.A.
FC890625 24P

1,1,1-Trichloroethane has become a viable coating option for compliance with volatile organic compound (VOC) regulations. The exempt status of this compound in the VOC regulations has positioned it as a unique tool for formulating compliant coatings. This paper explores the reasons for the use of 1,1,1-Trichloroethane, the other alternatives available and the methodology of formulating coatings with 1,1,1-Trichloroethane as the major solvent. Using solubility theory and relative evaporation rate, one can reformulate existing coatings formulations into compliant coatings that will meet the requirements of the VOC regulations.

Conversion to Powder Coating Case Study: American Yard Products
Yeboah, Isaac
American Yard Products, Incorporated
FC890627 11P

Converting to powder coating from liquid paint has helped solve a lot of environmental, quality and cost methods of the finishing process at American Yard Products. Furthermore, it gave us the flexibility needed to meet today's high cost of finishing.

QC/QA Field Application for Painted Parts
Reseland, John C.
Calgon Vestal Laboratories
FC890629 16P

ASTM quality control specifications provide guidelines for the evaluation of finished goods as they relate to the marriage of pretreatment, top coating, and their subsequent synergistic performance, often, these tests are not performed on a routine basis to assure quality finished goods. This paper explains these tests, their interrelationships, and the importance they have in the manufacturing process. Also, it is a practical guide toward setting up a quality assurance program to allow users to document and control their operations for good manufacturing practices (GMPS). Specific tests discuss adhesion corrosion control. A discussion is presented of the tools needed, the documentation schedules, and how log sheets enhance the program and give a practical and easy format for the end user. The focus is on developing a practical easy-to-use "How-to" procedure of assuring that the manufactured goods will represent the highest quality possible.

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Effects from Treatment of Paint in Water-Wash Spray Booths on Waste Classification and Management
Chambers, Bryce
Invirechem, Incorporated
FC900633 7P

Water scrubbers can efficiently entrap solids from paint overspray, though resulting waste characteristics are largely determined by the selected chemical additive to the spray booth's water. Chemical action can be designed to produce either paint agglomeration or slurry of paint in water, though in practice the treated waste often behaves in various combination modes. This paper discusses waste classification, regulations applying, and relevant waste management principles and options.

Designing Environmental Compliance into a World Class Finishing Operation
Grear, Robert D.
Navistar International Transportation Corporation
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This paper provides insight into how Navistar created and implemented highly innovative compliance technology for air and water at new truck finishing lines. Highlighted are a case study of the development of robotic application, recirculated-air paint booths, and thermal incineration into a new standard for controlling emissions of liquid coatings operations. Having created the technology, it was also necessary to develop a protocol for testing and certification of something never accomplished before. A dramatic reduction of pollution has been achieved while providing a world class manufacturing operation for finishing.

Environmental Regulations and Paint Sludge Management Alternatives for Compliance
Nassos, George P.
Chemical Waste Management, Incorporated
FC900635 13P

Proposed regulations by the U.S. Environmental Protections Agency forced the automotive industry to seek alternatives to landfilling of paint sludge. To the benefit of the automotive industry, the final regulations were relaxed and the disposal alternatives would be acceptable only if cost-effective. More effective dewatering of the paint sludge provides flexibility in the ultimate disposal as well as cost efficiencies.

Pollution Abatement of Metal Finishing/Manufacturing Wastes
Olaluwoye, Samuel
Norris Industries
FC900636 10P

The quest for a clean and habitable environment has prompted the development of treatment technology for, among other things, industrial and manufacturing wastes. Metal finishing wastes incorporate wastes and wastewaters from chemical drag-outs and spent chemical/processing baths (solutions). Each of these waste streams requires specific treatment chemistries. The chemical application for each treatment train is subject to the compound's stoichiometric reactivity and its ionic potential. The applied precipitation and flocculation are commonplace technologies used and needed for effective waste treatment and removal of toxic constituents.

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Shields, Grace
Kratz, Karl
Calgon Corporation
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Acid Rain and Automotive Topcoats
O'Dwyer, James B.
PPG Industries
FC900640 6P

Acid rain destruction of automotive topcoats is a serious current problem. This work describes techniques of analysis of etched samples from the field and the results of these analyses. From these analyses, a differentiation of water spotting and etching has been established. Laboratory tests have been developed to mimic field failures. A series of standard coatings was tested and a correlation made between these tests and selected exposure sites. Finally, a comparison is made of the newest available coatings with improved etch resistance.

VOC-Compliant Polyurethane Coatings for Application in the Transportation Industry
Roesler, Richard R.
Rumer, Roger W.
Mobay Corporation-Coatings Division
FC900641 16P

Two-Component polyurethane coatings are known for their world class performance in automotive, truck, and aerospace primers and topcoats. Recent regulations have focused attention on coatings which can be applied with a limited volatile organic content (VOC). Urethane chemistry offers the coatings industry several means by which compliant coatings may be successfully formulated. This paper presents the availability of new low VOC coatings based on two-component and one-component polyurethane resin chemistries. The coatings presented are based on both solvent and waterborne resins. These resins are useful in formulating high-performance coatings in application areas such a primers, primer-surfaces, basecoats, colored topcoats, and clear topcoats.

A 2.30 VOC Compliance Enamel for Coating Metal Furniture
Regulski, Gary J.
BASF Corporation
FC900642 8P

For the past several years, the coatings industry has faced the challenge of increased regulation of solvent emissions. 2.30 lbs/gal VOC has been the standard in California and other states are quickly following suit. This paper discusses a coating that can be sprayed with

conventional equipment and maintain good physical properties while adhering to current 2.30 VOC regulations.

Waterborne Automotive Finishes
Fox, C.B.
ICI Autocolor
FC900643 10P

The combined forces of environmental protection, consumerism, energy conservation, and productivity are completely altering the nature of coatings used by the automotive industry, waterborne basecoats allow application of low-volume solids, thus producing optimum metallic effect while maintaining compliance with emission regulations. To control rheology and thereby sag resistance and metal flake orientation, a novel aqueous microgel polymer has been developed. Processing of these basecoats is similar to present solvent-borne finishes with the exception that stainless steel equipment must be used and water must be removed before application of clearcoat. The production feasibility of waterborne basecoats was first established in a Canadian truck assembly plant and in the next two years several other production facilities are expected to convert to this new technology.

Paint Film Laminate Technology for Painting Thermoplastics
Fridley, Charles H.
Avery, Automobile Division
FC900644 8P

The laminate painting process offers a production-ready method for painting thermoplastic parts without spray painting. This process provides a smooth, high gloss, painted surface without orange-peel that meets automotive finish requirements and has exceptional resistance to chemical etching. Solid colors, metallics, and graphic patterns can be produced. Because solvents are incinerated during paint laminate manufacturing, and the paint laminate is applied dry, the process generates extremely low VOC emissions. This paper describes how the paint laminate is manufactured, how it produces a painted part, and the advantages of the process.

Optimize your Finishing Line through Laboratory Analysis and SPC
Waddles, Ed
Midwest Industries
FC900645 6P

During the past several years, the emphasis on quality control has changed the way customers and manufacturers think and select products. Statistical process control has played a significant role in the way a product is produced at every level of manufacturing. This paper details an approach to implement an SPC system into our conversion coating and paint lines. There were both economic and finished product quality benefits realized. Topics covered are: quality of supply water to the washer; incoming chemical quality; specific gravity and color checks for each batch of paint before the product is used in production, and frequent salt spray testing on all finishing lines.

Planning and Implementing Statistical Process Controls on a Powder Paint Line for Aluminum Alloy Wheels
Del Rivero, Gustavo
Rosales, Oscar
American Racing Equipment
FC900646 27P

The paper outlines the planning and implementation of SPC on a powder paint line. The paper relates the actual process implemented at American Racing Equipment. The discussion describes the planning, implementation, monitoring, tools and equipment, personnel training, and performance evaluation of a successful SPC program. Eight SPC characteristics are discussed along with the Deming management philosophy that has made the SPC program a success.

Waste Minimization and Resource Recycling in Paint Booth Operations
Bazell, Phillip G.
Bazell Associates, Incorporated
FC900648 7P

The industrial paint spray booth is certainly a microcosm of the environmental problems facing the industrial community. All phases of industrial waste are present: solid, liquid, and gas. Large volumes of water, precious natural resources found in the paint, and volatile organic compounds, both liquid and gas, combine to create an environmental problem of substantial proportion. While recognizing these various problems, this paper deals with proven means to recycle water and dramatically minimize the volumes of

solid and liquid waste leaving industrial painting facilities. Several case histories are presented which illustrate the potential savings to be realized by elementary waste water management strategies and waste minimization. Some discussion is also included regarding the dry filter method of collecting oversprayed paint pigment.

State and Federal VOC Guidelines for Coating Plastic Parts
Koreck, Joseph C.
Morton International
FC900655 13P

The technical justification content, and status of Michigan Rule 632 is discussed. The Federal Clean Air Act implications on Rule 632 and the status of the U.S. Environmental Protection Agency development of control technique guidelines for plastic parts coating operations is discussed.

Protecting Plastics and Plastics Coatings Using Light Stabilizers
Schirmann, Peter J.
Ciba-Geigy Corporation
FC900676 18P

The need for durable coatings is clear. They provide the first line of defense against the elements which cause structural corrosion and degradations as well as providing aesthetic appeal to products. The increasing need for higher solid coatings which utilize lower molecular weight backbone with higher functionality coupled with lower curing temperatures has generally presented problems maintaining coating durability for coating formulators. Often the durability of higher solids coatings can be dramatically improved by the use of light and heat stabilizers. This paper discusses general mechanisms for polymer degradation, manifestations of degradation on coating performance, types of stabilizing additives, and their functions and mechanisms. Examples of stabilization are presented. The paper indicates how the use of stabilizing additives can function as an important tool to provide to the coatings formulator a wider latitude of polymer and pigment choices while maintaining the desired degree of durability.

Development of Corrosion Resistant Tinplate DI Cans with an Improved Conversion Coating Film
Hayashi, Nobuyuki
Toyo Seikan Kaisha, Limited
FC900779 12P

The exposure of the base steel of tinplate is known to be present on the outermost surface of DI can bodies. Exposed iron causes early perforation or under film corrosion (UFC) as coexistent tin does not behave as a sacrificial anode to iron in coated cans. To reduce steel exposure and UFC, a surface treatment was developed, a kind of conversion coating of an extremely thin film of tin, phosphorus, and oxygen. To evaluate iron exposure of uncoated cans, a specially designed composite electrode was used.

Improved Drying Technologies for Water-Based and Solvent-Based End Compounds and Coatings
Sprenger, Barbara
Morland, Robert
Mountaingate Engineering Incorporated
FC900782 14P

As the can-making industry moves toward the use of non-VOC producing compounds and coatings, a new drying technology is required for drying and curing of these sealants. Innovation in this area stopped when the industry moved away from water-based compounds in the 1940s, and is just beginning again. This paper discusses new dryers available for water-based seaming compounds, dryers which can catalytically burn the VOCS emitted from the most popular solvent-based compounds, induction drying and heating of can ends, and new dryers required for the repair coating process on easy open ends.

Paint Process Monitoring and Control
Prylon, Brian T.
General Motors Corporation
FC910260 19P

To maintain optimal painting transfer efficiency and consistent appearance quality, appropriate paint process monitoring and control must be in place for real-time control as well as for process trend analysis. The objectives of this project are to develop a system that initially provides monitoring functions in three basic areas: the application process; the application environment; and the finished quality. Development also involves computer integration with sensors and

controls, first for use as an "open loop" control system then for "closed loop" application. Completely automatic operation is a long-term goal after appropriate production data, trend analysis, and mathematics modeling.

Total Process Management
Kordick, Charles J.
Chemical Systems, Incorporated
FC910362 8P

One of the many challenges faced by the finishing industry is the need to gain control of the pretreatment chemical process. This paper details the facets of a program designed to achieve this control. A successfully implemented total process management program has a positive impact upon the performance, environmental, and economic needs of the industry. The challenges of manufacturing demand such an approach to chemical pretreatment in the finishing industry.

The New Emphasis on Pollution Prevention
Sasson, Anthony
Ohio Environmental Protection Agency
Sullivan, Robin
United States Environmental Protection Agency
FC910360 12P

Pollution prevention is recognized as the preferred approach to managing the costs of environmental improvement. It is fundamentally different from pollution control, which stresses treatment, collection, and disposal of wastes and environmental releases. Instead, it concentrates on source reduction and recycling. Pollution prevention can be considered as part of a societal trend to improve the production of goods with less environmental damage. A growing number of corporations and trade associations are adopting the pollution preventional approach. Governments are active in incorporating the concept into their programs, including legislation and technical assistance. Finishing has a variety of relatively new technologies which may be used to achieve pollution prevention.

Environmental Regulations and Paint Sludge Management Alternative for Compliance
Nassos, George P.
Chemical Waste Management, Incorporated
FC910361 12P

Proposed regulations by the U.S. Environmental Protection Agency (EPA) forced the automotive industry to seek alternatives to landfilling of paint sludge. Companies serving the automotive industry developed unique processes to manage paint sludge, but the EPA did not cooperate. The final regulations were relaxed and paint sludge continued to be landfilled. Now the service industry is offering cost-effective alternatives, including converting the paint sludge to a solid fuel for use as a coal substitute. The key feature is more effective dewatering at a low cost.

Autodepositon--The Environmental Advantage
Jones, Thomas C.
Parker + Amchem
FC910371 9P

Autodeposition utilizes aqueous dispersions of polymer, pigment, and activators to coat metal. The process eliminates the need for a conventional conversion coating. The coating bath operates at room temperature and is chemically, rather than electrically activated. Autodepositon has a high coating transfer efficiency, energy use efficiency and eliminates volatile organic compounds.

Economic Analysis of Alternative Paint Spraybooth Solvent Emission Controls
Kenson, Dr. Robert E.
Met-Pro Corporation
FC910381 8P

The economic analysis of alternative paint booth solvent emission control systems shows that the cost-effectiveness of a specific system or type of system varies with the industrial service and type of paint booth. Broad generalizations about which is the most cost-effective control system should not be made without specific reference to actual applications. This presentation shows by specific example how the choice of the most cost-effective paint booth solvent emission control system should be done. Rotary carbon concentration, incineration, regenerative thermal incineration, and recuperative thermal incineration systems are evaluated in the same example for three different representative cases.

Enhanced Painting Efficiency Through Waste Minimization
Wagner, William C.
Wagner Consultants
FC910382 16P

This paper has been prepared and is offered as a guide for today's finishing managers as they strive to develop an effective waste reduction program within their finishing operation. It will clearly demonstrate that there are a multitude of improvements that can be made without the need to invest in new equipment or a totally new system. This paper is designed to show you that there are a variety of cost-effective opportunities that will enhance overall painting efficiency when coupled with a waste minimization program.

Waste Water Treatment--Avoiding the 10 Most Common Mistakes
Dudley, Richard P.
Water Management Services, Incorporated
FC910383 9P

This paper provides information to help non-waste water experts solve minor problems arising in the operation of a waste treatment system. It also helps people who design systems. The seven basic process steps (plus options for a total of 10-15 in a typical system) are discussed. The relationship between chemical and mechanical processes is discussed. Many have trouble because most people are mechanically oriented and often use a mechanical solution where a chemical one would be better. The 10 most commonly made mistakes are discussed, and readers are shown how to apply this information to improve their operation and save money.

New Solvent Control Strategies--The Systems House Approach, Hydrophobic Zeolite Absorbent
Blocki, Stephen W.
ABB Flakt Alpha
FC910385 12P

Several goals must be considered concurrently when developing solvent emission control plans. This paper reviews the best means of reaching the most cost-effective control strategy, the systems house approach. Also presented is a state-of-the-art solvent separation technology, hydrophobic zeolite absorbent. Hyrdrophobic zeolite has many characteristics which enable the user to eliminate peripheral equipment, making a solvent emission control system easier to use and less expensive to install and operate, while maintaining or improving system performance. An example illustrates the impact the systems house approach and hydrophobic zeolite can have on a complete solvent emission control system.

Determining the Best Corrosion Coating for the 21st Century
Brantley, Michael
E-Z-Go
FC930396 14P

This paper provides an in-depth explanation of the process used by E-Z-Go Division of Textron, Inc., to determine the most effective corrosion protection system for cold rolled and galvanneal parts used on recreational and industrial vehicles. In developing this system, consideration was given to future environmental regulations regarding VOC emissions and waste treatment and disposal. A matrix of various pretreatment and coating systems was developed. The results of the testing process are detailed in this paper.

The Effect of Relative Humidity in Dirt Control
Castle, G.S.P.
Komjathy, J.
Kunick, S.M.
The University of Western Ontario
FC930397 9P

In automotive painting anywhere from 5-40% of paint jobs need to be retouched due to the presence of surface dust contaminants. It is recognized that painting operations appear to suffer fewer rejects due to particle contamination when the relative humidity of the paint shop area is high. The variables studied included relative humidity, dust loading and circulation air velocity.

Rust Preventive Applications
Rohrer, John Carl
Almco Steel Products Corporation
FC930398 17P

This paper presents a case history of a successful effort to prevent rust. The paper discusses the history of the

project, identifies the root causes, reviews the comprehensive product testing program and presents innovative applications of the solvent cut back petroleum product which was selected. These unique applications were developed due to the need to protect parts prior to heat treat and to replace water in a leak (bubble) test tank.

Reducing Exterior Automotive Paint Costs via Pigment Selection
Misogianes, Milton J.
Ciba Pigments
FC940101 30 PP

In the coating industry, the term automotive paint invariably signifies excellence. These quality paints are characterized by attractive appearance, long term durability, colorful hues and relatively high cost. Recently economic pressures forced automotive paint manufacturers to reduce paint cost to the automotive companies. As a consequence, these paint companies have turned to pigment suppliers for support.

Cost-Effective Mechanically Plated Coatings
Chesner, Ray
Wisconsin Mechanical Metal Finishers Incorporated
FC940160 10 PP

Sometimes coatings are specified which are not the best for meeting the corrosion protection requirements and functional requirements of a part. When this happens, resulting coating costs can be very high. A properly coordinated coating is often less expensive and may provide improvements in the corrosion protection and overall quality of the part. Mechanical coatings can be engineered to meet a variety of requirements and often provide the most cost effective solution.

Automated Inspection of Finished Surfaces
Raafat, Hazem M.
Taboun, Salem M.
Hill, Fred J.
University of Regina
MS890206 10P

Detection of multiple defects on a surface of specified material is an application of machine vision in the manufacturing environment. Several procedures have been developed to detect the existence of defects such as scratches, cracks, or bubbles which may occur during production processes and handling of materials such as glass and plastic. However, few procedures classify the determined defect. This paper presents an algorithm for detection/classification of both multiple defects and the color quality of the inspected material.

Texture Analysis of Automotive Finishes
Jain, Anil K.
Farrokhnia, Farshid
Alman, David H.
Michigan State University
MS900587 16P

The appearance of metallic paint finish used in the automotive industry is affected by color as well as texture of the finish. One of the factors that determines the acceptability of the finish is the degree of "uniformity" of its texture. This paper discusses a texture analysis technique, motivated by a multi-channel filtering theory of the human visual system, to obtain quantitative measures that capture the characteristics of the texture. Two alternative schemes are proposed for grading texture uniformity based on these "texture features." High correlations between the resulting grades and the visual scale values assigned by trained technicians are observed.

EDM Machines CNC or Non-CNC--That Is the Question
Caron, Richard A.
Ingersoll GMBH (Inc.)
MS910482 7P

This discussion explores, with some detail, the abilities and advantages of today's CNC electrical discharge machine. It reviews the most recent improvements in CNC machine tool design. It explores the advancement of CNC programming and how this will aid first-time operators. A real work situation is reviewed, comparing CNC and Non-CNC EDM on a specific job. And, finally, the paper looks at the reasoning for CNC EDM purchasing.

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Edited by D. Ulrich
AFP/SME Powder Coating Division
175 pages, software, 1993
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This directory lists more than 200 organizations and international companies with descriptions of their products and/or services. Directory listings include fabricators/manufacturers, material suppliers, tooling, test laboratories/equipment,

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102 pages, softcover, 1993
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Clean Air Act Amendments – Impact on Finishing Industries

This report is a summary of expert opinion and commentary concerning the anticipated impacts of the Clean Air Act Amendments of 1990 on coating formulators, equipment manufacturers, and users. Discussions emphasize concerns for new technologies, emissions treatment methods, product quality and durability, research and development, state implementation considerations and permit programs, record keeping, and communicating. You'll also find an overview of the 1990 Clean Air Act Amendments, glossary of acronyms and terms and much more.

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