SOLVENT RECOVERY IN RUBBER TECHNOLOGY APPLICATIONS

Walter B. Stumpff
BFGoodrich Company
Tuscaloosa, Alabama

INTRODUCTION

Certain applications in Rubber Technology require solvent systems. Paints, lubricants, cements, inks, and release agents nearly all require some type of solvent - varying from water to very sophisticated multiple blend hydrocarbon systems. The trend today is toward water-based formulas as one way of reducing hazardous waste generation; however, the Rubber Industry still has applications where gasoline type solvents are required. In such cases any waste generated is classified as Hazardous due to an inherent characteristic of being flammable. There is readily available equipment on the market today that has the capability of recovering the solvent from those waste streams for reuse. This paper reviews one of those applications.

TEXT

For discussion purposes, we will limit specific comments to those gasoline based solvents systems used in tire manufacturing. The selection of equipment, of course, must be determined by the chemical characteristics of the single or multiple solvent system actually in use, and if cements or rubber solutions are involved, a "teflon" or other non-stick surface will be required for the charge vessel. It should also be noted that at the time this paper was being prepared there was still no clear understanding of how the January 4, 1985, preliminary rules issued by the EPA would effect the use of solvent recovery by a generator. Hopefully this cost-effective way of reducing hazardous waste will be encouraged and promoted.

I can tell you that through the use of a simple live steam process such as used in the Dyna 1 System manufactured by DCI Corp. of Indianapolis, Indiana, it is very easy to recover gasoline solvent from a tire paint which has been rendered useless in its primary application due to dissolved material, contamination, foreign material, improper blend, or the introduction of water into the waste stream when filters are back flushed and cleaned.

Through our experience we have determined that an azeotropic system is needed for tire and rubber related wastes.

During normal use many industrial solvents become contaminated with dissolved material forming solutions. Dissolved material cannot be separated from the solvent by settling or filtering. Where the contaminants have high boiling points, distillation is a feasible method of recovering solvents in their original condition by freeing the solvents from the dissolved contaminating materials.

Our system was designed primarily for the elimination of hazardous waste through azeotropic distillation. Azeotropic distillation is the introduction of live steam into the evaporator chamber for purposes of transferring heat energy to vaporize liquid solvents at a boiling point lower than the boiling point of solvent or water. For example, xylene boils at approximately 300°F. When introduced with steam, the combination or azeotropic boiling point of xylene and water is 202°F.

There are other considerations too, that recommend the use of azeotropic distillation systems. For example, many industrial solvents decompose at elevated temperatures resulting in char in the solvent and the release of permanent gases that will not condense under ordinary conditions. Elevated temperatures can also alter the characteristics of the residue in an undesirable manner.

To begin the distillation cycle, a predetermined volume of contaminated solvent is introduced into an evaporation chamber by a feed pump. Upon completion of the filling cycle, a valve on the suction side of the feed pump closes. Simultaneously, the steam inlet and recirculation valves open, introducing low pressure steam (8-10 PSI) into the contaminated bath through a sparging bar. The feed is recirculated continuously to provide even heat distribution and keep contaminants in a fluid state.

Through atmospheric (vented to atmosphere) operation of the system, each solvent has a characteristic temperature corresponding to the vapor pressure for that solvent at which point the solvent is described as boiling.

The evolving vapor passes over into a condenser where the solvent vapor is cooled below its boiling point, condenses back again to liquid solvent, and then collects in a transfer tank. When a prescribed level in the transfer tank is achieved, a float activates the transfer pump and the solvent/water mixture is fed into a coalescer/separator. The coalescer unit is capable of removing 100% of the free water from immiscible solvents. At this point, the distilled, de-watered solvent is pumped out of the coalescer into a holding tank for re-use.

Our system remains in the distillation mold until over 99% of the input solvent has been vaporized. As the concentration of solvent in the evaporation chamber becomes minimal (less than 1% by volume), the temperature inside the evaporation chamber begins to rise. Once the vapor temperature reaches a preset level, the steam inlet and recirculation valves automatically close and the drain valve opens to expell the fluid, solvent-free residue. There are no convection surfaces, thus eliminating residue bake-on and minimizing system maintenance. Once the residue has been drained from the evaporation chamber, all valves reposition and the system automatically begins a new distillation cycle.

Contaminants the system will remove from solvents include:

- o Mineral oils
- o Greases
- o Waxes
- o Dissolved and undissolved soaps
- o Detergents
- o Most fatty acids
- o Dyestuffs and other coloring material
- o Fine insoluble material like metal particles, soil and dirt
- o Dissolved solids
- o Pigments and resins

Equipment costs range from $75 per gallon capacity for large units up to $1650 per gallon capacity for very small units. Installation costs are in addition and will vary depending on your particular application and services required.

Industries currently using this type equipment include:

- o Automotive
- o Paint and industrial coatings
- o Fiberglass
- o Metal working
- o Pharmaceutical
- o Motor manufacturer (gasoline & electric)
- o Magnetic tape
- o Wire coating
- o Appliance & furniture
- o Paper & paper converters
- o Adhesives
- o Ink manufacture and printing
- o Dry cleaning
- o Cosmetic
- o And of course tire manufacturing

Potential savings are controlled by the volume of solvents you are now discarding, the method of disposal and of course, the value of the discarded solvent. Today, costs ranging from over $1.00 per gallon on up to $10.00 per gallon are possible when alcohols, aromatic solvents, aliphatics, and chloronated hydrocarbons are involved.

Operational costs are relatively low usually under 25¢ per gallon, so that once equipment costs are written off (in our case that took less than a year) the savings become substantial and all go to that important bottom line on the P/L statement.

Through the use of solvent recovery and changes in applied technology which permitted the change to water based solvent systems, or the complete elimination of certain solvent applications, it has been possible for us to completely eliminate the need to discard waste into the ecology through land fill or other waste disposal. In fact, we have been able to change our waste problem from a cost item to a savings item. Pollution prevention does pay.