TECHAPPLICATION

Electric Resistance Indirect Radiant-Heated Sand Reclaimer Economic Answer to Sand Reclamation

Published by The EPRI Center for Materials Production CMP-087

THE CHALLENGE:

To Reclaim Used Chemically-Bonded Sands Efficiently and Economically.

BACKGROUND

Empire Steel Castings is a 70-year old foundry located in Reading, Pennsylvania. Empire uses organic no-bake (chemically-bonded sand), green sand, oil, and shell systems for producing molds and cores. About 6,000 tons of silica sand are used per year for their chemically-bonded sand operation. The metal casting process, in which molten metal is poured into bonded-sand molds, exposes the sand at the metal interface to high temperatures that burn out the sand binders and leave a residue which is detrimental to the reuse of the sand.

In the past, Empire simply discarded the used sand as "fill" on their property or had the sand trucked to an off-site landfill. However, the number of landfills is decreasing and the tipping charge for dumping used sand is becoming prohibitive. Consequently, it is now more desirable to reclaim sand for reuse in the foundry.

CONVENTIONAL METHODS

Three methods of sand reclamation are commonly used–dry, wet, and thermal, However, only thermal reclamation burns off the binders by heating the sand to a minimum temperature of 950 to 1000° F. The quality of the reclaimed sand is equal to that of new sand. Until recently, most thermal reclaimers used in the United States were gas fired.

THE NEW WAY

Thermal reclaimers using electric power offer unique advantages over gas-fired units. The electric units do not require large quantities of air to support combustion; and since fuel is not burned in the reclaimer, the sand is not contaminated. Complete reclamation of chemically-bonded sand can be achieved at lower temperatures, minimizing thermal-shock cracking of the sand grains. Further, electric-fired units are easier to automate and can be programmed to integrate with plant power demands to improve load factor and avoid increasing peak demand.

Recognizing these advantages, Empire chose to install an electric-fired sand reclaimer manufactured by Castec, Inc. of Muse, Pennsylvania. Their design features a batch-type electric resistance, indirect radiant-heated reclaimer under the trade name, Thermpak™. The Thermpak unit offers a high degree of sand recovery and low energy requirements.

DESIGN AND OPERATION

The entire system is frame mounted, prepiped, and prewired to minimize the cost and time required for installation. At Empire, the complete system is housed in a new building, see Figure 1.

The process begins by feeding the used chemically-bonded sand from a storage silo to a six-ton hopper, which is an integral part of the system, see Figure 2. The sand is then metered, in one-ton batches, into the thermal treatment vessel where reclamation takes place. The thermal treatment vessel is surrounded by two insulated heating jacket sections. Six heating coils, each 480 volts, are mounted inside the sections to provide heating. Inside the vessel, the unreclaimed sand mixes with the retained hot fluidized sand heel. The sand is heated to temperatures of 1000 to 1400°F. Hot fluidizing air oxidizes the binder remaining on the sand grains.

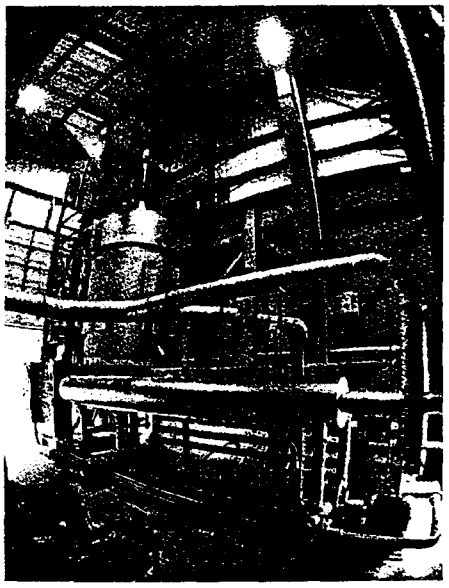

Figure 1. The Thermpak electric reclaimer system averages only 125 kWh per ton.

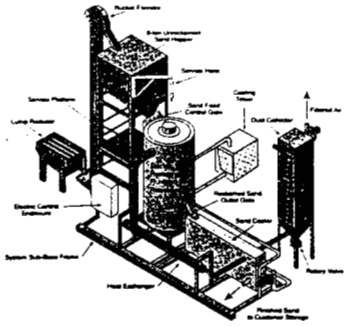

Figure 2. Schematic of Thermpak electric-fired sand reclaimer.

After about 1 hour, the hot reclaimed sand is automatically discharged into the batch sand cooler where the sand is cooled in a fluidized bed by contact with submerged water-cooled tubes. After cooling, the sand is automatically discharged and transferred to a holding silo. The reclaimed sand is now ready for reuse in mold and coremaking operations. Typically, as much as 98 percent of the sand is reusable. The remaining 2 percent is collected as "fines" and disposed in a landfill.

OPERATING EXPERIENCE

In addition to an excellent sand recovery rate, the Thermpak system has demonstrated superior cleaning, ease of control, minimal maintenance requirements, safe operations, and reliability. The reclaimed sand passes all standard foundry sand quality tests. Further, the castings produced with the reclaimed sand exhibit excellent quality and surface finish.

Energy use for the thermal unit alone averages as little as 85 kWh per ton of sand. After a year of 24 hours-a-day operation, energy usage for the entire system, including motors, fans, and illumination, has averaged only 125 kWh per ton. Peak demand for the total system has been 175 kilowatts with an 83 percent utilization.

The excellent results are best stated by Mr. Ed Crowley, President of Empire: "Our decision to install an electric sand reclaimer has proven to be a wise business and economic move, and more importantly we have eliminated many present and future environmental problems."

ROLE OF ELECTRIC UTILITY

Dave Hillanbrand of Metropolitan Edison Company (Met-Ed) proposed a collaborative project with EPRI/CMP for funding a demonstration of the Castec unit at Empire Steel Casting, a customer of Met-Ed. Subsequently, Dave Hillanbrand became a prime mover in obtaining substantial funding for the project from the Pennsylvania Energy Office. In addition, Bob Branch of Met-Ed was instrumental in getting the Pennsylvania Electric Energy Council (PEERC) to contribute funding. The utilities in PEERC that contributed funding were Met-Ed, Pennsylvania Power & Light Company, Pennsylvania Electric Company, and Duquesne Light Company.

COMPANY PROFILE

The Company was originally named Electric Manganese Steel Casting Company, and in December 1921 made their first heat of steel. In 1926, the company was sold to a New York financier and renamed Empire Steel Castings Company. Since that time Empire has changed owners several times. Ed Crowley joined the firm in March 1985 and today continues to direct the company as president, CEO, and majority stock holder.

Today Empire Steel is a specialty steel foundry that produces castings of carbon, low-alloy, and stainless steel that are used in valves, pumps, compressors, turbines, and other special applications including nuclear applications.

Empire's melting equipment consists of two, two-ton per hour electric arc furnaces and three induction furnaces each with a capacity of 2,400 pounds.

Edward Crowley, President of Empire Steel Castings, Inc. and Dave Hillanbrand, Engineer III for Met-Ed inspect the interior surface of a globe valve casting.

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Applicable SIC Codes: 3325, 3362.

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For ordering information, call EPRI's AMP Program 1-800-4320-AMP

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