

Foundry Core Production

Process Description:

The constituents for making sand cores at foundries consist of sand, resin and a catalyst to quickly set the resin. A common practice in core production is the use of a phenolic-based cold box (PUCB). In the PUCB system, sand is added into the cold box mold and mixed with the binder (resin), typically phenolic-based. Upon sealing the sand/binder mixture, a catalyst is gassed into the sealed cold box to act as a “quick set catalyst.” Catalysts include triethylamine (TEA gas) and diethanolamine (DEA); both are hazardous air pollutants (HAPs). The catalyst gas exits the cold box and is treated with an acid scrubber. The acid scrubber converts the catalyst gas into a salt which may be recovered by a distillation process. The distillation recovery of the catalysts is often performed by the catalysts’ vendors.

Waste Streams:

The cold box core production system inherently produces two streams of emissions. First, the binders are generally phenolic compounds that emit volatile organic compounds (VOCs) and hazardous air pollutants. Second, the catalyst gases, although highly recoverable in the acid scrubber, produce fugitive emissions and solid waste. In addition, the storage and handling of the phenolic binders and catalyst gases can result in safety and environmental risks if spilled or released.

Pollution Prevention Opportunities

In foundry core production, pollution prevention opportunities exist in two areas:

1. Binder

Alternatives exist for the phenolic-based binders which are most commonly used in the cold box core making method. One such replacement is a protein-based binder that forms a reversible gel in water and dries to a rigid, partially crystalline polymer when the water is removed with heat. Protein-based binders are composed of biodegradable materials, thus eliminating the HAP emissions. Protein-based binders have demonstrated success with lighter, lower temperature castings but are unproven for high temperature, heavy castings such as iron. An alternative binder and resin utilizes alkaline, water-based resin that is cured by carbon dioxide (CO₂) rather than TEA or DEA, eliminating the need for the HAPs.

Improvements to the traditional phenolic-based cold box (PUCB) core making system have been developed. These developments include the use of biodiesel or methyl ester solvents as the resin/binder material resulting in lower VOC emissions during core making and lower HAPs at pouring, cooling and shakeout.

2. Catalyst

Catalyst type is dependent upon the binder used. By selecting protein-based or alkaline, water-based resins the use of catalysts gases (TEA or DEA) can be eliminated. A new catalyst called DMIPA (dimethylisopropylamine) has shown to react better than TEA thus reducing catalyst consumption and the associated releases.

Another pollution prevention opportunity for the cold box core making technique is to recover the catalyst gases from the exhaust of the cold box (filter the gas if needed) and reuse back in the cold box. The catalyst gas (TEA) may need to be condensed into a liquid if the existing core machines require. This recovery substantially reduces the use of catalyst gases, thereby reducing fugitive air emissions and solid waste. In addition, successful implementation may provide the opportunity for the elimination of air pollution control equipment upon the demonstration of insignificant TEA or DEA emissions.

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Pollution Prevention Checklist

- Evaluate the potential to use an alternative binder such as a protein-based, an alkaline, water-based binder, biodiesel or a methyl ester solvent binder.
- Consider the recycling the amine gas catalyst back into the cold box (filtration or condensation may be required).
- Consider alternative catalysts such as DMIPA or carbon dioxide (CO₂).

Note:

This FACT sheet serves as a suggestion document only and shall not to be used as a regulatory requirement. The above suggestions will not work in all situations and their successes are contingent upon factors inherent to each individual facility.

Jbe
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References:

“Advances in Core Making Technology”, Foundry Management and Technology; April, 2004.