SOME STUDIES AND INVESTIGATIONS OF FOUNDRY WASTES FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

Ferrous foundries generate lots of amount of waste. India is the world’s second largest producer of castings and also one of the top 10 in terms of average production per plant, but our share of the global market is below 2 percent. It is estimated around 5000 Foundries are operating all over India. Many Indian foundries have not implemented new environmental conscious technology because they are not aware the source of wastes in their foundry and intensity of wastes. The objective of this paper is to investigate foundry wastes for implementation of cleaner production in foundry particularly for MSEs (Micro and Small enterprise) to sustain the environment for Indian foundries.

Keyword: Ferrous foundries, cleaner production, MSEs

1. INTRODUCTION

Basic foundry processes vary only slightly from one foundry to another. All foundry operations Produce castings by pouring molten metal into molds, often consisting of molding sand and core sand. Once the casting has hardened, it is separated from the molding and core materials in the shakeout process. The castings are cleaned, inspected, and then shipped for delivery Figure 1 is a schematic of a typical foundry process, showing both finished product and the types of air emissions and wastes generated The processes involved for molding, melting, and casting are accompanied by evolution of dust, gases, heat, and noise. For foundries, the focal points are: air-emission, efficient use of raw materials & energy, waste reduction, in conjunction with any recycling and reuse operation [1, 2].
1.1 Materials inputs and potential pollutant outputs for foundry

1.1.1 Pattern Making

In pattern making process, material inputs may be wood, plastic, metal, wax, polystyrene and pollutants outputs given below.
Air Emissions:
VOC (volatile organic compound) from glues, epoxies, and paints.
Waste water: Little or no wastewater generated but there is no plan for water utilization.
Residual Wastes: Scrap pattern materials [3].

1.1.2 Mold and Core Preparation and Pouring

In this process, materials inputs may be sand and chemical binders and pollutants outputs given below.
Air Emissions:
Particulates, metal oxide fumes, carbon monoxide, hydrogen sulfide, sulfur dioxide, and nitrous oxide. Also, Benzene, phenols, and other hazardous air pollutants
Wastewater:
Wastewater containing metals, elevated temperature, phenols and other organics from wet dust collection systems and mold cooling water
Residual Wastes:
Waste mold and core sand potentially containing metals and residual chemical binders [3].
1.1.3 **Charging and Melting**

In charging and melting process, material inputs may be metal scrap, ingot and returned castings and pollutant outputs given below.

**Air Emissions:**
- Products of combustion, oil vapors, particulates, metallic oxide fumes

**Wastewater:**
- Scrubber wastewater with high pH, slag cooling water with metals, and non-contact cooling water

**Residual Wastes:**
- Spent refractory material potentially containing metals and alloys [3].

1.1.4 **Pouring**

In this process, material inputs ladles and refractory materials and pollutant outputs given below.

**Air Emissions:**
- Particulates, metallic oxide fumes

**Wastewater:**
- Little or no wastewater generated

**Residual Wastes:**
- Spent ladles and refractory materials potentially containing metals [3].

1.1.5 **Shakeout, Cooling and Sand Handling**

In this process, material inputs may be water and caustic for wet scrubbers and pollutant output given below.

**Air Emissions:**
- Dust and metallic particulates; VOC and organic compounds from thermal sand treatment systems.

**Wastewater:**
- Wet scrubber wastewater with high or low pH or amines, permanent mold contact cooling water with elevated temperature, metals and mold coating

**Residual Wastes:**
- Waste foundry sand and dust from collection systems, metal [3].

1.1.6 **Felting**

In this process, material inputs may be unfinished castings, water, steel shot, and solvents, and pollutant outputs given below.

**Air Emissions:**
- VOCs, dust and metallic particulates

**Wastewater:**
- Waste cleaning and cooling water with elevated temperature, solvents, oil and grease, and suspended solids

**Residual Wastes:**
- Spent solvents, steel shot, metallic particulates, cutting wheels, metallic filings, dust from collection systems, and wastewater treatment sludge [3].
2. METHODOLOGY

In India there are more than 5000 foundries in India (The institute of Indian foundrymen2012). There are many hubs of foundries like West Bengal, Gujarat, Maharashtra, Tamilnadu, Karnataka, Andra Pradesh and Jharkhand. Ahmadabad, located in the state of Gujarat, is an important foundry cluster in Western India. There are about 600 foundry units in Gujarat. The cluster came-up mainly to cater to the casting requirements of the local diesel engine industry. The geographical spread of the cluster includes vatva, vidyanagar, Rajkot, Bhavanagar etc. To have true picture of these hubs, foundries from Ahmadabad were chosen for study of investigation of wastes. Data is collected from 3 different foundries (foundry (f1), foundry (f2), foundry (f3)). These foundries produces castings by sand castings. All these foundries are ferrous in nature. Waste measurement is carried out with the help of XYZ enviro care private. Ltd at Vatva. The purpose of taking help of XYZ enviro care private. Ltd Vatva is to have an accurate and precise reading so that real interpretation can be made. Data is compared with the standards of CPCB (Central pollution control board and MOEF (Ministry of environment and forests).

3. RESULT AND DISCUSSION

The following results were obtained from the three foundries. The readings are as below.

Table 1. Experimental results of solid waste

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Waste</th>
<th>Concentration in mg/kg</th>
<th>Cu</th>
<th>Zn</th>
<th>Pb</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F1</td>
<td>F2</td>
</tr>
<tr>
<td>1</td>
<td>Sand waste</td>
<td>220</td>
<td>190</td>
<td>182</td>
<td>79</td>
<td>71</td>
</tr>
<tr>
<td>2</td>
<td>Dust</td>
<td>166</td>
<td>143</td>
<td>151</td>
<td>169</td>
<td>138</td>
</tr>
<tr>
<td>3</td>
<td>Slag waste</td>
<td>520</td>
<td>482</td>
<td>543</td>
<td>306</td>
<td>297</td>
</tr>
<tr>
<td>4</td>
<td>Waste From Ladle</td>
<td>141</td>
<td>130</td>
<td>150</td>
<td>340</td>
<td>312</td>
</tr>
<tr>
<td></td>
<td>MOEF Standard</td>
<td>300</td>
<td>1000</td>
<td>100</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>
Table 2. Experimental results of Air emission

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>PM in µg/m³</th>
<th>NO₂</th>
<th>SO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
</tr>
<tr>
<td>1</td>
<td>Furnace operation</td>
<td>3155</td>
<td>1977</td>
<td>3529</td>
</tr>
<tr>
<td>2</td>
<td>Preparation of cores and moulds</td>
<td>3404</td>
<td>2134</td>
<td>4919</td>
</tr>
<tr>
<td>3</td>
<td>Casting</td>
<td>1853</td>
<td>1667</td>
<td>2577</td>
</tr>
<tr>
<td>4</td>
<td>Shakeout and reclamation</td>
<td>4376</td>
<td>3147</td>
<td>5381</td>
</tr>
<tr>
<td></td>
<td>MOEF standard</td>
<td>3000</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 3. Experimental results of Wastewater

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>pH</th>
<th>BOD</th>
<th>COD</th>
<th>Suspended Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F1</td>
</tr>
<tr>
<td>1</td>
<td>Cooling baths</td>
<td>9.3</td>
<td>NA</td>
<td>NA</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>MOEF Standard</td>
<td>6-8.5</td>
<td>30</td>
<td>250</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4. Experimental results of Noise Pollution

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>Pollution (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F1</td>
</tr>
<tr>
<td>1</td>
<td>Scrap handle</td>
<td>78</td>
</tr>
<tr>
<td>2</td>
<td>Furnace Operation</td>
<td>82</td>
</tr>
<tr>
<td>3</td>
<td>Shakeout</td>
<td>86</td>
</tr>
<tr>
<td>4</td>
<td>Compressor</td>
<td>90.3</td>
</tr>
<tr>
<td>5</td>
<td>Knockout</td>
<td>92</td>
</tr>
<tr>
<td>6</td>
<td>Crane heads</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>CPCB Standard</td>
<td>75</td>
</tr>
</tbody>
</table>

NA-Not applicable.
4. CONCLUSION

From above table following conclusion can be made
1. The foundries generate lot of Solid waste like sand waste, dust, and slag waste, waste from ladle which is harmful for human health. There is no arrangement for beneficial reuse, disposal, treatment and handling.
2. Regarding air emission, Small and medium size foundries from Ahmedabad hub are emitting pollutants from different department namely Furnace operation, Preparation of cores and moulds, Casting, Shakeout and reclamation. There are drastic deviations in all department compare to MOEF Standard. There is low air emission where induction furnace is installed but they are not running with highest efficiency. Cupola is the predominant melting furnace used by nearly 90% of the foundry units. Most of the cupolas are of conventional type. A local cupola design, called 'Rajkot cupola', is quite popular in the cluster.
3. Regarding wastewater, there are drastic deviations in all parameter compare to MOEF standard. There is no arrangement for reuse of waste water.
4. Regarding noise pollution, there are drastic deviations in all department parameter compare to CPCB standard.

There is a tremendous scope for these foundries to use the high quality raw material for reduce the solid waste and also use the various devices like Filters, Cyclones, Mechanical Collectors, Scrubbers to enhance the awareness in relation with cleaner production idea. There is a lack of economical information for many recent techniques. There is need of awareness with this regard towards moving for sustainable development.

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REFERENCE


Http://www.unep.org


