METAL INDUSTRIES

BY

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Metal wastes include wastes from

- Refining mills.
- Plating mills and parts
- Washing

They are characterized by their toxicity, relatively low organic matter, and greases

Steel Mill Wastes

Three type of steel manufacturers

- Integrated producers
- Mini steel mills
- Specially steel mills

Integrated Producers
• They use Iron ore and coal and produce many shapes of steel,

Mini mills
• They reprocess scrap steel usually to some low quality products

Specialty steel mills
• They are similar in sizes to mini steel mills but produce more expensive items

Origin of Steel Mill Wastes
• Wastes come mainly from by-product coke, blast furnace, rolling mill and pickling departments
• Wastes contain phenols, ore, coke, lime stone, acids, alkalis, soluble and insoluble oils
• Wastes are treated by, evaporation, benzol extraction, distillation, sedimentation, neutralization, skimming, flotation and aeration
The “by product” coke process

- Coal is heated in the absence of air to produce coke and other products
- Cooking process produces Coke, ammonium sulphate, tar, phenol, light oil, naphthalene and other gases
- Major wastes from preparation of coke product itself come from quench water. Where hot coke is flooded with water
- Coke dust present in this quenching water is called **breeze** and is commonly recovered for water

The blast furnace

- Wet scrubbing of blast furnace gas evolves water laden with flue dust
- Wet scrubbers are down flow water sprays which clean dust from up flowing gases
- Secondary gas washes or electrostatic precipitators are periodically cleaned by flushing with water

The pickling process

- For final finishing steel is immersed in dilute sulphuric acid (15-25% by weight) to remove dirt, grease, iron-oxide scale which accumulates on the metal during fabrication
- Pickling produces wastes called **pickling liquor**. It mainly composed of acids and iron salts of acids
- Acid reacts with iron salts, and forms FeSO4.
### Characteristics of Steel mill wastes

<table>
<thead>
<tr>
<th>Characteristic (ppm)</th>
<th>Source of wastes</th>
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<tbody>
<tr>
<td></td>
<td>Ammonia Still</td>
<td>Final</td>
<td>Pure</td>
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<tr>
<td></td>
<td></td>
<td>Cooler</td>
<td>Still</td>
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<tr>
<td>BOD</td>
<td>3974</td>
<td>218</td>
<td>647</td>
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<tr>
<td>TSS</td>
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<tr>
<td>VSS</td>
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<tr>
<td>Organic and NH3-N</td>
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<td>105</td>
<td>20</td>
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<tr>
<td>NH3-N</td>
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<tr>
<td>Phenol</td>
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<td>Cyanide</td>
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<td>pH</td>
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</table>

**Blast furnace**

- Blast furnace wet-scrubber effluent contains flue-dust solids and contains iron oxide, alumina, silica, carbon, lime and magnesia

**It depends upon**

- Type of ore used in furnace
- Conditions of the furnace lining
- Quality of coke used
- Number of furnaces in blast
- Amount of air being blown
- Regularity and thoroughness of dumping and flushing of dry dust catches
Pickling process

• Amount of waste per ton of steel depends upon the size and type of plant
• Increase in volume due to steel products when rinsed in water after they leave the pickling tank to remove all traces of acid
• The rinse or wash water eventually becomes quite acidic and must also be discarded.
• H2SO4 and FeSO4 are the major contaminants

Treatment of steel mill wastes

• Primary method of treatment of by-product coke plant wastes is to use recovery and removal unit (Phenol recovery).
• By product recovery may be undertaken for profit. Ammonium sulphate, crude tar, naphthalene, coke dust, coal gas, benzene toluene and xylene
• Gravity separators are used to remove free oil from wastes from benzol stills
• Phenol may be removed by either conversion into non-odorus compounds or recovery as crude phenol or sodium phenolate.
• In treating flue dust, sedimentation, followed by thickening clarifier overflow with lime to encourage flocculation. (Removal of iron oxide and silica)
• 90-95% suspended matter settles readily and does so within a one hour period resulting an effluent with 50 ppm SS.
• Primary and secondary thickened sludge’s (lime coagulated) are also obtained which can then be lagooned without creating nuisance
• Treatment of pickling liquor is a problem of considerable magnitude. For small steel plant it is not commercially viable and they neutralize it with lime
• Some compounds do obtained as by-product from this waste like Fe$_2$(SO$_4$)$_3$, H$_2$SO$_4$, Fe$_3$O$_4$ for polishing or pigments, iron powder etc.
• Neutralization with lime is costly and time consuming (Slow settling sludge)

**Neutralization takes place in 4 steps**
• Formation of ferric hydrate with a pH below 4.
• Formation of acid sulphate.
• Formation of ferrous hydrate with a pH between 6-8.
• Formation of normal sulphate.
• Calcium and dolomite lime are least expensive caustic soda and soda ash are most expensive

**Areas for change in the pickling waste pollution.**
• Improvement in treatment of waste from pickling with H$_2$SO$_4$.
• A new HCl pickling operation.
• A new dry descaling operation.
• New treatment methods for H$_2$SO$_4$ pickling include deep well disposal
• HCl pickling differs from H$_2$SO$_4$ pickling in a way that HCl readily dissolve all the various oxides of iron in the scale but reacts slowly.
• Dissolved solids in the HCl pickle liquor is far below the extraction concentration and steel is left clean and free of crystal or insoluble lime.
• H$_2$SO$_4$ reacts fast with parent metal and blows off oxides on strip. Because of this more scale breaking is required before pickling.
THANKS