Presentation On Lead Industry, Speciality Chemicals of Lead

Waldies Compound Ltd.

October, 2018
Waldies - Introduction

Waldies is one of the largest manufacturers of Lead Oxides in India. It owes its name to Dr. David Waldie, who was born in the early 19th century in Linlithgow, Scotland. He came to India and established in 1858 chemical works to produce various chemicals including Red Lead, a pigment previously not made in India. Waldies have thus, pioneered the chemical industry in India and were the first, in India, to introduce the manufacture of pigments on a large scale.

Waldies owned Griffin is the most prestigious brand in the industry. Its factory is located on the bank of River Ganges around 14 KMs from Calcutta. It is the most respected name in the industry and is well known for its high-quality products which are unmatched in India.

PRODUCTS

- Red Lead Ordinary
- Red Lead Non Setting
- Tribasic Lead Sulphate
- Lead Stearate
- Dibasic Lead Stearate
- Dibasic Lead Phthalate

![Timeline of Waldies History](image-url)
Phoenix on the Ganges

Waldies Compound has risen like the fabled bird from the ashes of David Waldie’s disillusion. Over a century and a half later, the Calcutta company set up by the Scotsman remains the only supplier of a critical component used for making glass panels in nuclear reactors.

SUCCESS(ION) IS ALL ABOUT PLANNING

Over the next five years, 80% of family businesses will be passing on the baton to GenX. The key to success and longevity lies in how they plan this transition. Early succession planning, succession training, and governance with an emphasis on succession are the steps that can help. 

Waldies has undergone some management changes, but their products are still of the highest quality. The company has diversified into other sectors, including electronics and pharmaceuticals. The company is now managed by the third generation, with the goal of ensuring continuity.

Tale of the Saddened Scotsman

Despite its success, Waldies has faced challenges. The company’s founder, David Waldie, was a serial entrepreneur who had a knack for innovation. He started the company with a simple idea of making glass panels for the nuclear industry. However, the company faced problems in the early years due to competition from other companies. Despite these challenges, Waldie persevered, and the company steadily grew.

LEADING WITH LEAD

80% of family businesses will be passing on the baton to GenX. The key to success and longevity lies in how they plan this transition. Early succession planning, succession training, and governance with an emphasis on succession are the steps that can help. Waldies has undergone some management changes, but their products are still of the highest quality. The company has diversified into other sectors, including electronics and pharmaceuticals. The company is now managed by the third generation, with the goal of ensuring continuity.

Is your business prepared for a Data Disaster?

It should be!

Waldies - Introduction
Lead Uses and Applications

Key Facts of Lead Industry

- Lead is malleable blue-grey metal found in association with Zinc, silver as well as Copper ores.
- Lead has some unique properties such as resistance to water and corrosion, ductile in nature and can be coiled and uncoiled easily, owing to which it is the preferred metal across various industrial applications.
- One of the most recyclable and sustainable commodities. Recycled lead accounts for more than 60% of total lead production.
- Automobile industries, Hospitality, educational institutes, computerization and Banking sector are backbone for growth of Lead demand.
- 75% of Lead produced is used for manufacturing of Lead acid batteries specially the one used in automobiles, motorcycles, electric cars and bicycles. Ongoing clean energy initiatives such as wind power and solar cells give further market for lead acid batteries.

Sector wise uses of Lead metal

- Batteries 74%
- Rolled & Extruded Products 8%
- Others 4%
- Pigments & Compounds 9%
- Alloys 3%

- Cable Sheathing 2%

Uses of Lead

- Battery
- Sheet
- Pipes
- PVC Stabilizer
- Bearing Metals
- Glasses & Ceramics
- Alloys
- Lead Powder
- Paints & Enamels
- Capsules for wine bottles
- Security Seals
- Lead weights
- Lead shots/ammunitions
- Figures/Ornament
- Window came
- Radiation Shielding
Lead is produced by 40 countries in the world. Five countries namely China, Australia, USA, Peru & Mexico produce about 80% of the world production. Each of the five countries produces over 100,000 tonnes of lead every year.

The world mine production of lead which was 3,200 thousand tonnes in 2003 increased to 4,100 thousand tonnes in 2009 registering an increase of 28% in 6 years. India was placed at sixth position with a production of 83 thousand tonnes in 2009.
Overview of Lead Industry in India

- India is the fifth largest producer of lead contributing to around 3.3% of the global lead production. Production of refined lead has grown at an average rate of 14.5% since 2008-09.
- India is endowed with large resources of lead ores. The occurrences of lead & zinc ore are distributed over 3 major regions- Bhilwara, Rajsamand District, Udaipur District; Rajasthan has the largest resources i.e. 90% of the total resources, followed by Bihar (2%), Maharashtra (2%) and MP (1%).
- Around 76% of the lead consumed in the country is used for manufacturing lead acid batteries. Of this, around 60% is accounted by automobile sector and the rest 40% is contributed by other users of batteries such as UPS, inverters and telecom sector.
- Government has streamlined procedure to conduct exploration and develop new deposits; Significant resource potential at existing mines are explored
- India also recycles Zinc & Lead from the inevitable waste arising like used lead batteries, Zinc Dross, scrap etc., in an environment- friendly manner

- Zawar lead and zinc belt
- Rajpura-Dariba lead-zinc belt
- Ajmer lead-zinc belt
- Rampura Agucha lead-zinc belt
- Rangpo lead-zinc-copper deposit, Sikkim
- Deri-Ambaji lead-zinc belt
- Pur-Banera lead-zinc belt
Future Scenario for Lead Industry

- The global outlook predicts that by 2030, of all the battery systems, 94% of them will continue to be lead batteries.
- The present capacity of lead recycling is about 1 million tonnes which will increase further in view of the more organized recycling industry and impact of Battery management Rule will show its effect on the LAB collection and recycling.
- Based on the scenario it has been presumed that in secondary lead production there will be an increase by 25% as the demand of battery.
- All batteries have a fixed life time, say up to three years, and the spent batteries will come back for recycling which will result in increased production of secondary lead.

Future demand of lead based on growth of batteries

<table>
<thead>
<tr>
<th>Batteries/Vehicles (Nos.)</th>
<th>2010-11</th>
<th>2015-16</th>
<th>2020-21</th>
<th>2024-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Consumption (tonnes)</td>
<td>48,049</td>
<td>81,845</td>
<td>139,410</td>
<td>213,471</td>
</tr>
</tbody>
</table>

Future growth of vehicles

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of vehicle</th>
<th>Average growth %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dumper</td>
<td>2.83</td>
</tr>
<tr>
<td>2.</td>
<td>Wheel mounted dump loaders</td>
<td>5.20</td>
</tr>
<tr>
<td>3.</td>
<td>Commercial vehicles</td>
<td>7.28</td>
</tr>
<tr>
<td>4.</td>
<td>Jeep type vehicles</td>
<td>7.54</td>
</tr>
<tr>
<td>5.</td>
<td>Passenger Cars</td>
<td>10.22</td>
</tr>
<tr>
<td>6.</td>
<td>Auto Rickshaws</td>
<td>6.58</td>
</tr>
<tr>
<td>7.</td>
<td>Scooters &amp; Mopeds</td>
<td>5.33</td>
</tr>
<tr>
<td>8.</td>
<td>Motor Cycles</td>
<td>5.89</td>
</tr>
</tbody>
</table>
Scrap Recycling

- Lead has the highest rate of recycling of all the metals. Due to its corrosion resistance, lead scrap is available for recycling, decades or even centuries after it is manufactured.
- The principal source of lead scrap for recycling throughout the world is lead acid batteries. Scrapped lead acid batteries and the associated production plant scrap represents over 90% of the contained lead available for recycling. Other lead scrap materials for recycling include sheaths from telephone and power cable, lead pipe and sheet, printing metals, anodes, residues, dross's, sludge's, and dusts.
- Currently, just about half of the total world lead production of 4.7 million tons comes from the recycling of lead scrap. In recent years, the amount of recycled lead has been increasing and this rate of lead production is expected to increase in the future.
- The battery recycling processes have changed dramatically over the past ten to twenty years. The changes have stem from environmental regulations, technological changes, changes in battery distribution and sales techniques, lead-smelting technology, and lead alloys.

State wise capacities of lead battery waste processors (2011)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>State</th>
<th>No. of Unit</th>
<th>Capacity (Tonnes/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>12</td>
<td>80,120</td>
</tr>
<tr>
<td>2</td>
<td>Assam</td>
<td>2</td>
<td>2,100</td>
</tr>
<tr>
<td>3</td>
<td>Chattisgarh</td>
<td>5</td>
<td>3,300</td>
</tr>
<tr>
<td>4</td>
<td>Gujarat</td>
<td>14</td>
<td>37,370</td>
</tr>
<tr>
<td>5</td>
<td>Haryana</td>
<td>28</td>
<td>57,755</td>
</tr>
<tr>
<td>6</td>
<td>Himachal Pradesh</td>
<td>2</td>
<td>25,100</td>
</tr>
<tr>
<td>7</td>
<td>Jammu &amp; Kashmir</td>
<td>9</td>
<td>74,960</td>
</tr>
<tr>
<td>8</td>
<td>Karnataka</td>
<td>21</td>
<td>1,06,240</td>
</tr>
<tr>
<td>9</td>
<td>Kerala</td>
<td>3</td>
<td>3,700</td>
</tr>
<tr>
<td>10</td>
<td>Madhya Pradesh</td>
<td>29</td>
<td>75,315</td>
</tr>
<tr>
<td>11</td>
<td>Maharashtra</td>
<td>41</td>
<td>1,26,762</td>
</tr>
<tr>
<td>12</td>
<td>Punjab</td>
<td>26</td>
<td>20,420</td>
</tr>
<tr>
<td>13</td>
<td>Rajasthan</td>
<td>43</td>
<td>1,82,940</td>
</tr>
<tr>
<td>14</td>
<td>Tamil Nadu</td>
<td>13</td>
<td>72,620</td>
</tr>
<tr>
<td>15</td>
<td>Uttar Pradesh</td>
<td>22</td>
<td>1,30,600</td>
</tr>
<tr>
<td>16</td>
<td>West Bengal</td>
<td>46</td>
<td>98,566</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>316</td>
<td>1,097,876</td>
</tr>
</tbody>
</table>

Estimated Primary & Secondary Lead Production India

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary Lead CAGR-14.62%</th>
<th>Estimated Production</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-11</td>
<td>83</td>
<td>166</td>
<td>adding 100% secondary production</td>
</tr>
<tr>
<td>2015-16</td>
<td>164</td>
<td>369</td>
<td>adding 125% secondary production</td>
</tr>
<tr>
<td>2020-21</td>
<td>323</td>
<td>808</td>
<td>adding 150% secondary production</td>
</tr>
<tr>
<td>2024-25</td>
<td>557</td>
<td>1532</td>
<td>adding 175% secondary production</td>
</tr>
</tbody>
</table>

Generalized flow diagram of lead acid battery recycling
Red Lead is used to a certain extent in the ceramics and glass, paints and pigments and explosives industries. This formula corresponds to a PbO\textsubscript{2} content significantly lower than 34.0% dependent upon the particular application in which they are to be used. Red lead non-setting is a variant of red lead consisting of reactive litharge in very minute quantity. This variant is composed of high quantity of lead peroxide. Red Lead setting or RLNS is available freely in nature in a powdered form. Waldies Sindur and anti-corrosive paint to cover steel structures. Such types are significantly used to prevent undue thickening of paints. Red Lead Ordinary appears in a vibrant orange to red brick colored pigment which had a chemical property to be able to get dissolved in acetic acid and completely insoluble in water and ethanol.

### Table: Battery Industry Material Share of battery weight [%]

<table>
<thead>
<tr>
<th>Material</th>
<th>Share of battery weight [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>25</td>
</tr>
<tr>
<td>Lead oxides</td>
<td>35</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>10</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>10</td>
</tr>
<tr>
<td>Water</td>
<td>16</td>
</tr>
<tr>
<td>Glass</td>
<td>2</td>
</tr>
<tr>
<td>Antimony</td>
<td>1</td>
</tr>
</tbody>
</table>

**PLUMBING INDUSTRY**
Lead is used in the Plumbing industry from over thousands of years to the first plumbing systems, which are named after the word “lead” in Latin, Plumburn.

**BATTERY INDUSTRIES**
Red Lead is primarily one of the main raw materials for the manufacturing of tubular batteries. The wide market of these batteries makes Red Lead a vital part in the procedure.

**GLASS & CERAMICS**
The addition of lead oxide to glass raises its refractive index and lowers its working temperature and viscosity. The attractive optical properties of lead glass result from the high content of the heavy metal lead.

**PAINTS & PRIMERS**
Lead paint or lead-based paint is paint containing lead. As pigment lead(II) chromate (PbCrO\textsubscript{4}, chrome yellow), Lead (II,IV) oxide, (Pb3O\textsubscript{4}, red lead), and lead(II) carbonate (PbCO\textsubscript{3}, white lead) are the most common forms. Lead is added to paint to speed up drying, increase durability, maintain a fresh appearance, and resist moisture that causes corrosion. It is one of the main health and environmental hazards associated with paint.

**EXPLOSIVES**
Red Lead is used in the Explosives industry to a certain considerable extent.
Lead Oxide

Lead(II) oxide, or **litharge**, is a yellow oxide of lead of formula PbO, created by heating lead in the air. It can also be formed by heating lead(II) nitrate(V) (Pb(NO₃)₂). Litharge is amphoteric, meaning it reacts with acids to form Pb²⁺ and with bases to form plumbate(II).

The product is a useful ingredient for the storage battery, glass & ceramic industry. It occupies an important place in the manufacturer of power cables. Conforms to IS : 58-1976

Manufacturing of Lead Oxide – Barton Oxide Technology
Export of Lead oxide from India

Total Quantity of Lead Oxide Exported (2016)
15,426 Tonnes

Top Countries for Export
• United Arab Emirates
• Iran
• Saudi Arabia
• South Korea
• Germany

Top Ports of Exports from India
• Nhava Sheva Sea
• Mundra
• Chennai Sea
• Hyderabad
• Pipavav Port
The global plastic stabilizer market can be segmented based on stabilizer type, plastic type, end-use industry, and region. In terms of stabilizer type, the plastic stabilizer market can be divided into thermal stabilizer, antioxidants, light absorber, fire retardants, and microbial stabilizers.

In terms of plastic material, the plastic stabilizer market can be classified into thermoplastic, thermosetting, and elastomers.

The major properties of PVC compounds incorporating lead stabilisers include:

- Excellent heat and light stability.
- Good electrical properties.
- Excellent short and long-term mechanical properties.
- Low water absorption.
- Wide processing range.
- Good cost/performance ratio

### Type of Stabilizer vs Lead Content

<table>
<thead>
<tr>
<th>Type of Stabilizer</th>
<th>Lead Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetra-basic lead sulphate</td>
<td>85%</td>
</tr>
<tr>
<td>Tri-basic lead sulphate</td>
<td>82%</td>
</tr>
<tr>
<td>Di-basic lead phosphite</td>
<td>82%</td>
</tr>
<tr>
<td>Di-basic lead phthalate</td>
<td>75%</td>
</tr>
<tr>
<td>Di-basic lead stearate</td>
<td>51%</td>
</tr>
<tr>
<td>Normal lead stearate</td>
<td>28%</td>
</tr>
</tbody>
</table>

### Growth Drivers
- Growing PVC usage in Piping
- Increasing Plumbing and Electrical Piping in Construction

### Restraints
- Impending Global Ban on Lead Stabilizers
- Fluctuating Raw Materials Prices

### Opportunities
- Emergence of Organic Stabilizers
- Customised one-pack additives
Advantages of Lead sheathed cables – Petrochemical industry
A lead sheath can be used as a chemical barrier in low, medium and instrumentation cables for all kinds of petrochemical projects. The advantages of lead sheathed cables are:
- Protection against the entry of hydrocarbons.
- Protection against moisture ingress.
- Can be used as an earthing or grounding system.
- Excellent corrosion resistance.

Disadvantages of lead sheathed cables
Besides the advantages of lead sheathed cables, there are also some disadvantages. Lead is both a heavy and a soft metal. The heavy weight of this metal is regarded as a disadvantage since it increases labour intensity, making it more costly to install. Furthermore, there are also environmental concerns of using lead in underground cabling systems. Lead is harmful and even in some Scandinavian countries forbidden to be used in the ground.
Lead Stabilizers

**Tribasic Lead Sulphate**, $3\text{PbO, PbSO}_4, \text{H}_2\text{O}$, is the most popular and versatile lead stabilizers for PVC. It is one of the most cost effective stabilizers available and is used in both rigid and plasticized PVC compounds for a wide range of end product applications.

TBLS has excellent stabilizing properties in PVC. The special surface coating increases the effectiveness of lower concentration permitting manufacturing PVC compounds and products of lower stabilizer usage and hence low cost.

**Lead Stearate** $\text{Pb}(\text{C}_{17}\text{H}_{35}\text{COO})_2$ and Dibasic Lead Stearate, $2\text{PbO, Pb}(\text{C}_{17}\text{H}_{35}\text{COO})_2$ are basic lead soap of commercial stearic acid.

These are versatile combined lubricants and heat stabilizers for PVC. Lead Stearate and Dibasic Lead Stearate have wide application as a lubricant for Plasticised PVC compounds, particularly cable covering.

For rigid PVC applications, it is necessary to use a well-balanced lubricant system.
Lead Stabilizers

**Dibasic Lead Phthalate, 2PbO-PbC6H4(COO)2 1/2H2O**, is an excellent heat stabilizer, particularly at high temperatures, besides being also effective as a light stabilizer.

It confers excellent long-term protection on Phthalate plasticized PVC compound which is to be subjected to aging at elevated temperatures, due to its low reactivity with plasticizers, particularly the polyester type. This is of particular advantage in cable sheathing.

**Dibasic Lead Stearate, 2PbO, Pb(C17H35COO)2** are basic lead soap of commercial stearic acid. These are versatile combined lubricants and heat stabilizers for PVC. For rigid PVC applications, it is necessary to use a well-balanced lubricant system.

LS is primarily of interest as a lubricant in PVC compound since it has only moderate heat stabilizer properties when used alone. It is generally used in conjunction with other stabilizers.

**USED AS LUBRICANTS**
Lubricants are essential for the majority of PVC fabrication methods by the very nature of the polymer. Lead Stearate acts as an efficient lubricant for many such processes.

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**PVC CABLE COMPOUNDS**
It is suitable for all types of pigmented PVC compound, particularly those requiring a long period of heat stability.

**FOAMED PVC**
Application of DBLP as a 'stabilizer kicker' is also very common.

**CABLE SHEATHING**
Lead sheath (Lead or its alloy-variants and sometimes Aluminium) helps prevent the primary moisture ingress and is also rugged in underground applications.

**PLASTICIZED PVC COMPOUNDS**
Lead Stearate along with other PVC Stabilizers has a wide application as a lubricant for Plasticized PVC compounds

**CABLE COVERING**
Electrical cables whose conductors are protected from moisture and mechanical damage by a lead sheath and covering.

**RIGID PVC APPLICATIONS**
Lead Alloys

Because lead is very soft and ductile, it is normally used commercially as lead alloys. Antimony, tin, arsenic, and calcium are the most common alloying elements. Antimony generally is used to give greater hardness and strength, as in storage battery grids, sheet, pipe, and castings.

- Unalloyed lead has poor wetting characteristics: Because lead is very soft and ductile, it is normally used commercially as lead alloys.
- Antimony, tin, arsenic, and calcium are the most common alloying elements.
- Antimony generally is used to give greater hardness and strength, as in storage battery grids, sheet, pipe, and castings.
- Antimony contents of lead-antimony alloys can range from 0.5 to 25%, but they are usually 2 to 5%.

Calcium Lead Alloys
Alloys have replaced lead-antimony alloys in a number of applications, in particular, storage battery grids and casting applications.

- These alloys contain 0.03 to 0.15% Ca.
- Some minor elements such as aluminum, silver, bismuth and some alkaline earth metals are also added to lead-calcium alloys to improve the alloy properties and the battery performance.

Antimony Lead Alloys
Application:

- Antimony Lead Alloy - 3.0: For making small parts in HD batteries, also in COS Fusion
- Antimony Lead Alloy - 4.5: Automotive / Tubular Grids
- Antimony - Selenium Lead Alloy: For making Automotive / Tubular grids.

Antimony generally is used to provide more hardness and strength. Antimony contents of lead antimony alloys from 2 to 5%. Lead Antimony Alloys are used widely in the chemical industry for pumps and valves in chemical plants and radiation shielding.

Tin Lead Alloys
Commonly used for their good melting, & casting properties, as in type metals and solders.

- Tin increases the hardness and strength. Lead tin solder is widely used, particularly by the electronics industry, also used in bearings and ornamental ware.
- Tin Lead Alloys is used in plumbing and electronic applications.
- Tin provides the alloy the ability to wet and bond with metals such as steel and copper.
Lead Smelting

Breaking the batteries and separating the materials

- Used batteries are broken using hammer-mills, saws, shears, or some combination of the above equipment. The batteries may be punctured to allow the acid to drain before they are broken. The broken batteries are usually conveyed to a separator, which separates the battery plates from the cases.
- Following the battery breaking, it is recommended to have a paste desulfurization unit to reduce the need for fluxing agents in the smelting process to minimize SO2 emission from the furnace. The plates are then sent to raw materials storage and the cases are sent for crushing to reduce the size.

Furnace Charge Preparation and Fluxing Agents

- Fluxing agents are added to the furnace to promote the conversion of lead compounds to lead metal and to remove impurities through slag formation.
- This charge content has a typical recovery rate of 64 percent, and will decrease the percentage of lead in the slag to less than 2 percent.

Smelting Process

- The smelting process is usually performed in blast, rotary, reverberatory, electric furnaces.
- The rotary furnace is used since it is easier to adjust the relative amount of fluxing agent because the furnace is operated on a batch rather than a continuous basis. This method suits the Egyptian smelting industry. It achieves better mixing of the charge contents.
- The furnace has high exhaust temperatures — up to 1,300°C. This temperature is high enough to burn all organic hazardous air pollutant.

Tapping and Casting Ingots

- At the end of the smelting cycle, the rotation of the furnace is halted, lead, slag are tapped from the furnace into crucibles from a single tap hole located at the edge of furnace shell.
- Both charge loading and lead tapping positions are hooded and vented to a pollution control system. Rotary furnaces produce a semi-soft lead.
## Emissions & Emission Control Techniques

### Process Exhaust Emissions
- Smelting furnaces are sources of metal hazardous air pollutants (HAPs) and particulates (PM).
- Metal HAPs are predominately compounds of lead, antimony, and arsenic, with smaller amounts of other metals compounds.
- The quantities of organic HAPs, THC, and CO emissions are dependent on the furnace type. HCL, CL\(_2\) and SO\(_2\) emissions are controlled in the furnace by adding the fluxing agents.

### Fugitive Emissions
- The main sources of process fugitive emissions are furnace charging, slag, tapping, agglomerating furnace operations, and battery breaking. Fugitive dust emissions contain metal.
- HAPs and PM, which are dependent on the size of the facility and the dust controls and work practices in place in the facility.

### Baghouses
- Baghouses are a well-known technology to control metal HAP process emissions from smelting furnaces. Wet scrubbers for acid gas control may follow the baghouse; however, no significant additional removal of metal HAPs is achieved.
- Many designs and operating parameters affect baghouse efficiency, such as bag material, pressure drop, air-to-cloth ratio, type of cleaning, and operating temperature. The average working temperature in the baghouse ranges between 120–180°C, depending on the sulfur content of the exhaust gases.
- Therefore, in most applications the exhaust gases should be cooled to that temperature before entering the baghouse. Different cooling systems may be installed after the furnace to accommodate the temperature requirements. Further cooling, below the sulfuric acid dew point, may cause corrosion of the baghouse metal frame and ductworks.

### Wet Scrubbers
- Wet scrubbers are capable of controlling HCL, CL\(_2\), and SO\(_2\) emissions. Important parameters
  - that affect the scrubber’s performance are scrubber type media and liquid-to-gas ratio.

### Hoods
- Hoods are used to control the fugitive dust from battery breaking, furnace charging, tapping, slag tapping, and agglomerating furnace operations.
- Dust is controlled by enclosing the source in a hood and ventilating the hood to a baghouse.
- The two most important factors in determining the efficiency of a hood in capturing fugitive emissions are the degree of enclosure and the air speed at the hood opening.
Thank you

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