ASPECTS OF SHOT BLASTING OVER PICKLING FOR METAL DRAWING PROCESS

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Abstract- In this paper we have tried to introduce the new advancement in metal drawing process. Metal drawing is a comprehensive technique which needs accuracy in the apprehension of working for higher order and its rectification. It is being the basic foundation to the vast automobile industry in India, needs to be filtered with new trends to increase quality and to reduce cost related to it. Metal drawing traditionally is a process with several steps which are complicated and tedious. In spite of several precautions there are lot of health hazards related to it. Thus, there arises the need for development of system for metal drawing which are eco-friendly, optimal, less time consuming and with better quality. The aim of present work is to validate the use of shot blasting process over pickling process as a part of metal drawing. We have tried to validate shot blasting over aspects like quality, cost, time consumption, scrap quantity and environment friendliness. Mild steel is the material used for metal drawing. Data has been collected for cost analyzing and time consumption for both the processes after regular survey in various industries and represented through graphs and chart to show the difference in the above two processes of metal drawing. The data depicts that out of the two processes, shot blasting is best technique for metal drawing in all the aspects. Final conclusion was drawn to justify the correct procedure for metal drawing.

Keywords- Metal Drawing, Pickling, Quality, Rectification, Shot Blasting.

I. INTRODUCTION

Pickling is a process to remove the oxide layers which are the side effects of hot rolling process. As hot rolling of metals is done above the recrystallization temperature of a particular metal to give it a required shape, Oxide layers or iron oxide crystals can be seen on the surface of metals. These layers and crystals act as obstacles for further processing of the metal. Same is in the case of metal drawing or bright bar manufacturing, where drawing cannot be done with those layers present on the surface. So as to remove those layers metal drawing companies follows pickling process. Where metal bars are immersed in a bath of acid. Carbon steels with an alloy content less than or equal to 6%, are often pickled in hydrochloric or sulphuric acid. Steels with an alloy content greater than 6% are pickled in two steps using other acids are used such as phosphoric, nitric and hydrofluoric acid. Rusted and acid-resistant chromium-nickel steels are pickled in a bath of hydrochloric and nitric acid. Most copper alloys are pickled in dilute sulphuric acid, while brass is pickled in concentrated sulphuric and nitric acid mixed with sodium chloride.

Outcome of acid cleaning is hydrogen embrittlement in which the hydrogen released from the acid reacts with the surface and makes it brittle and causes cracks. Pickling process causes production of harmful waste product known as pickling sludge.

Pickling sludge includes acidic rinse waters, iron chlorides, and metallic salts and waste acid which make it hazardous in nature. So Pickle sludge from steel processes is required to be neutralized with lime and disposed of in a landfill. After neutralization it no longer seems to be hazardous waste. The lime neutralization process raises the pH of the spent acid. The waste material is subject to a waste determination to ensure no characteristic or listed waste is present. Hydrochloric pickling sludge is often treated in a hydrochloric acid regeneration system, for which a treatment plant needs to be installed which recovers some of the hydrochloric acid and ferric oxide. The rest must still be neutralized and disposed of in landfill or managed as a hazardous waste based on the waste profile analysis. The by-products of nitric acid pickling are marketable to other industries for fertilizer processors.
By these pictures we can see the pickling process and pickled material.

Shot Blasting is also a surface treatment process in which surface cleaning is done using high velocity steel abrasive. Shot blasting is method through which it is possible to obtain excellent cleaning and surface preparation much better than pickling process.

Shot blasting is commonly used for:
- The cleaning of iron, steel, non-cast parts, forgings, etc.
- Mechanical cleaning of sheets, rods, coils, wire, etc.
- Shot peening to alter mechanical properties (increasing resistance to fatigue for springs, gears, etc.)
- Preparing surfaces to be painted, coated, etc.

Here we are discussing shot blasting process in terms of bright bar manufacturing.

In general shot blasting concentrates abrasive particles at high speed (65-110 m/second) in a controlled manner at the material thereby removing surface contaminates due to the abrasive impact. Shot blasting is used in almost every industry that uses metal, including aerospace, automotive, construction, foundry, shipbuilding, rail, and many others. The abrasive particles used by shot blasting called shots can be sand, small steel balls of various diameters, granules of silicon carbide, etc.

Shot blasting used as a part of bright bar manufacturing is a continuous process in which steel bars keeps on moving continuously with the help of rolls inside the chamber where they are exposed to the abrasive particles or shots and after the cleaned and descaled bar is then used for further processing. The abrasive material or shots are obtained from steel through a fusion process with controlled chemical composition.

Rounded particles that constitute the steel shot are obtained from the primary process of manufacturing. These particles in the state of largest diameter are split forming the angular steel grit and used as abrasives for shot blasting process. This abrasive is selected according to the work to be performed, not only by the size of the particle which is mostly uniform in all of them, but also be the hardness in certain range. They are easy recycled as being able to be projected from 700 to 5000 times according to the diameter, type and hardness of the abrasive used. Dust is produced in the operation is basically the result of the materials removed from the surface which is being treated.

The general characteristics of steel shots are like:
- shape : angular
- hardness : 40 a 68 RC
- density : 4000 kg/m^3
- meshes : 18 - 200
- reusing factor : 700 to 5000 times

These are some examples of shot blasting machines.

II. QUALITY

By descaling with the help of pickling process the patches of acids are seen on the surface of the material if the material is kept idle for 1-2 days, whereas in case of shot blasting no such patches are shown till date. In fact, the surface after shot blasting is shining. It also reduces the cost of material as less machining is required after shot blasting due to better descaling and the finished surface is completely free of scale, dust content and chemical deposit and blast surface is ideally suited for subsequent operation. On the other hand, special polishing machine is required for better surface finish in case of pickling which further adds on to the cost of the material and cycle time.
Surface shining which is the most important aspect of automobile industry is seen most in case of shot blasting as compared to pickling process due to the use of metal abrasive which clean the material completely and gives it best shine. A uniform silver matt finish is obtained in blast process without blemish.

There will be uneven expansion resulting in cracks in the scale and other contaminants. Those cracks extend to the paint film and to the base metal. Slowly patches of these scale loosen themselves from the base metal and fall off taking the paint film along with them.

While doing so, they expose the base metal, rust and the scale to the direct action of the atmosphere or the process conditions. Thus the damage is self multiplying, resulting in total plant failure and even reduction in size of the member. Therefore, it is evident that the member should be thoroughly clean of all foreign matters right to the virgin metal.

The better quality of material indirectly affects the demand of the material upto 2-3 times.

### Effect of Shot Size on impact & Coverage

<table>
<thead>
<tr>
<th>SHOT SIZE</th>
<th>Inches</th>
<th>mm</th>
<th>Approx. impact Value</th>
<th>Approx. Nos. Shots/lb</th>
<th>Equiv. Size of Grit</th>
</tr>
</thead>
<tbody>
<tr>
<td>.070&quot;</td>
<td>0.18mm</td>
<td>1</td>
<td>82,00,000</td>
<td>G-80</td>
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<tr>
<td>.0110&quot;</td>
<td>0.30mm</td>
<td>4</td>
<td>21,00,000</td>
<td>G-50</td>
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<tr>
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<td>1,92,000</td>
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<tr>
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<tr>
<td>.0390&quot;</td>
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<td>90</td>
<td>68,000</td>
<td>G-18</td>
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<td>G-14</td>
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<td>440</td>
<td>14,000</td>
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</table>

### III. HEALTH, ENVIRONMENTAL AND SAFETY

Whenever we come across the natural calamity or a man made disaster due to hazardous activity, then, we have to pay a heavy price in terms of colossal loss of life and property. The main difficulty experienced is that these calamities are quite often inevitable or cannot be predicted accurately. There are lot of hazards related to pickling process while descaling material as the labour is in direct contact with acid. But no such hazards are seen in case of shot blasting because no such hazardous material is used in case of it. In case of pickling process the major problem which come across is dumping of acid after use. Most of the vendors just directly dump the acid in water bodies like river or in a pit in earth against the government laws to save money. This acid mixes with water, land and air and cause all types pollution(land, air and water) making land and water unfit to use. But in case of no such problem come across and is free from any such type of pollution due to the use of metal abrasive for descaling. Safety of workers is major issue for any businessman as it is his duty to take of labour who all are working in his firm. Due to the use of acid in pickling process there is lot of risk factor related because a single drop of acid can cause burns on the skin and even intake of fumes of acid can cause death. So one had to take care of all such issues. But in case of shot blasting no such safety measures are required and is safer for workers to work on abrasive jet machines.

### IV. TIME MANAGEMENT

Time is most important factor in production. It is truly said that “Time is money”. The graph below shows the time consumption of pickling process of scales removing.

In case of blasting process time consumed for per tons of material for descaling is approximately half of time taken by pickling process. Due to less time consumption the production rate is much higher and per unit cost is less. In case of pickling even after descaling further other process has to be done in order to satisfy the surface finish demanded, which increases the cycle time for producing finished goods and thereby increasing cost and reducing production rate.

### V. METHODOLOGY

We can use several measures to compare these two processes. If we compare these on the basis of aspects...
Discussion on the Descaling, “Pitting Corrosion of 18Cr, An approach to the descaling function of misc.

While using pickling process we need to be more careful as constituents for pickling process are more as compared to shot blasting. In shot blasting we need to take care only about the abrasive (shots) materials and some miscellaneous aspects.

If we compare two processes on the basis of financial aspects then we come across the situation as.

**Pickling**

<table>
<thead>
<tr>
<th>Maximum sale(kg)</th>
<th>3000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale amount(($50/kg))</td>
<td>150000</td>
</tr>
<tr>
<td>Profit margin(($3/kg))</td>
<td>9000</td>
</tr>
</tbody>
</table>

**Shot blasting**

<table>
<thead>
<tr>
<th>Minimum sale(kg)</th>
<th>5200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale amount(($50/kg))</td>
<td>250000</td>
</tr>
<tr>
<td>Profit margin(($1.75/kg))</td>
<td>9100</td>
</tr>
</tbody>
</table>

As per industry norms by using pickling we can fulfil upto 3000 kg of demand of the market. Where as if we use shot blasting instead of pickling for the same time, we can fulfil minimum of 5200 kg of demand of the market.

So as per minimum and nominal conditions (just taken as reference for calculation) we are having an option to earn Rs. 100 more profit per day if we go for shot blasting over pickling. Also we are having sale amount of 2,50,000 as compared to 1,50,000 in pickling. So we can assume it good for our economy as more demand is fulfilled within same time period and thereby increasing money circulation.

**CONCLUSION**

Shot blasting process for descaling which is required for metal drawing process is more beneficial and effective over pickling process. The finished surface of drawn bars by shot blasting process is more clean and is free from any scales or crystals of oxide, making it easily acceptable in the market. The aspects discussed above (quality, health, time and cost) proves that shot blasting is much better process for descaling.

**REFERENCES**


[3] Li Tongqing et al, An approach to the descaling function of tension leveller


