Title: A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES

Abstract: A novel method for metal surface preparation to remove mill scale, rust & residues for the production and finishing of metal surfaces, and more particularly to the removal of scale from the metal surfaces, e.g., surfaces of metal sheet. More particularly the present invention relates to novel method for removing annealed scale, rust, oxide, mill scale, oil patch, black spot/patch from hot rolled and cold rolled. The novel process creates an ideal surface for paint adhesion especially on CRC & stainless steel. In addition, it prep the steel better than any acid chemicals currently available for wash systems. The said method is also used for the deburring, cleaning, washing, grainiing, de-greasing, de-scaling, finishing and surface preparation of different kinds of ferrous and non ferrous material by wet and dry processing.
A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES

Field of the Invention

The present invention method relates for the production and finishing of metal surfaces, and more particularly to the removal of scale from the metal surfaces, e.g., surfaces of metal sheet. More particularly the present invention relates to novel method for removing annealed scale, rust, oxide, mill scale, oil patch, black spot/patch from hot rolled and cold rolled. The novel process creates an ideal surface for paint adhesion especially on CRC & stainless steel. In addition, it preps the steel better than any acid chemicals currently available for wash systems. The said method is also used for the deburring, cleaning, washing, , graining, degreasing, de-scaling, finishing and surface preparation of different kinds of ferrous and non ferrous material by wet and dry processing. The present invention is a novel method for the preparation of eco pickle metal surface (EPMS)

Background of the Invention

Hot rolled & cold rolled steel, stainless steel and other ferrous and non ferrous metals are currently de-scaled by a process called Acid pickling, spot blasting and slurry blasting. Acid Pickling involves advancing the steel through long acid baths that remove the Scaled and oxide layers form metal surface. Most steel sheet, coil, Strips is pickled in
hydrochloric acid tanks at strip speeds of about 80 to 120 feet per minute. It is more difficult to remove scale from metal with desire speed. De-scaling process requires stronger acids such as, hydrofluoric, sulfuric, or nitric acid. Pickling of metal also requires longer times in the acid tank which reduces the line speeds for metal strip down to about 100 to 400 feet per minute. The disposal of byproducts resulting from the pickling process is hazardous, as well as costly, as the byproducts are considered to be toxic pollutants. Used hazardous chemical Disposal is also problem and expansive efforts.

Conducting the pickling process can also be problematic. Line stops, where the metal strip is stopped in the acid for an extended period of time, often result in over pickling. Over pickling may damage the surface of the metal strip. Different types of metals require varying acid mixtures for optimum pickling. If the same line is being used for multiple types of metal, line stops and changeover time are incurred when the acid mixture is changed. Pickled metal is left with a low pH (less than 7) causing the metal to reoxidize unless protected from oxygen by a layer of oil. The oil is expensive to apply and must be removed for certain downstream processing steps such as painting or coating.

Acid cleaning has limitations in that it is difficult to handle because of its corrosiveness, and it is not applicable to all steels. Hydrogen embrittlement becomes a problem for some alloys and high-carbon steels. The hydrogen from the acid reacts with the surface and makes it
brittle and causes cracks. Because of its high reactance to treatable steels, acid concentrations and solution temperatures must be kept under control to assure desired pickling rates. Due to acid reaction metal loose is also heavy during process. Acid pickling also has immense energy requirements due to the natural gas consumed in heating the acid tanks.

Pickling sludge is the waste product from pickling, and includes acidic rinse waters, metallic salts and waste acid. Spent pickle liquor is considered a hazardous waste by United States Environment Protection Agency (EPA). Pickle sludge from steel processes is usually neutralized with lime and disposed of in a landfill. After neutralization the EPA no longer deems the waste a hazardous waste. The lime neutralization process raises the pH of the spent acid and makes heavy metals in the sludge less likely to leach into the environment. Since the 1960s, hydrochloric pickling sludge is often treated in a hydrochloric acid regeneration system, which recovers some of the hydrochloric acid and ferric oxide. The rest must still be neutralized and disposed of in landfills. The by-products of nitric acid pickling are marketable to other industries, such as fertilizer processors.

Another different method like spot blasting and slurry blasting are also used in alternate to acid picking method. Descaling of metal surfaces can also be performed using two common blasting techniques spot blasting and slurry blasting. A first blasting technique uses relatively large particle spot at low velocities to assist in acid descaling. A second...
technique de-scales with a jet of sharp edged abrasive media such as sand, silicon carbide, aluminum oxide, or steel grit. Abrasive jet descaling is somewhat inefficient for two reasons. Continuous descaling of metals, particularly carbon and stainless steel, with abrasive media having sharp edges causes the media to embed itself into the steel surface. Therefore, heavy coverage with the abrasive media is needed to completely clean off the oxide layers.

U.S. Patent No. 6,088,895 to Nelson et al. discloses a method for descaling hot rolled strip that uses spot blasting in conjunction with tension leveling, brush cleaning and brush polishing. In particular, this patent discloses stretching the strip in tension to at least 1% elongation to level the strip and induce cracking in the scale covering the strip, spot blasting using metallic particles propelled from a blasting wheel to ablatively remove a portion of the scale, mechanically removing additional scale by using two pairs of counter-rotating wire brushes until the metal sheet reaches a surface roughness of 3.6 micron Ra, and polishing the strip with another pair of brushes to reduce the roughness to within a range of about 2.0 micron Ra.

In the spot or slurry blasting grit & contaminants getting embedded on the blasted surface. After spot blasting process metal surface is also harder, which is effected to reduce productivity in next operation.

To overcome all above stated limitation, in the present invention, In the present invented process, surface oxidation is removed using an
engineered abrasive and the process leaves the surface resistant to subsequent oxidation without the need for oil film or other protective coating. ECO PICKLED METAL SURFACE (EPMS) is a more direct replacement for acid pickling, spot blasting & slurry blasting.

SUMMARY OF THE INVENTION

The main object of the present invented method is for mechanical scrubbing with abrasives wire grit brush with normal water. This technology invented on the base of spot or slurry blasting process. With the high RPM horizontal axis rotating and Oscillating system is propelled onto the strip in a uniform stream that removes surface scale without removing the base steel. The extent of oxide removal is at least as thorough as acid pickling; however, steel abrasives brush also conditions the surface so it is cosmetically uniform and absent of acid picking's chloride residues that can accelerate rusting & surface remains rust free.

Mechanical scrubbing with steel abrasives wire brush is superior to dry spot blasting for removing oxides from strip, Abrasive brush is typically applied to hot band as it ships from the mill, but it also 'resuscitates' coils stored outside accumulated with rust and dirt, can be turned into prime material. Even steel treadplate can be brushed to remove rust and obtain a remarkably clean surface.

The present invented Eco Pickal Metal Surface (EPMS) method prevents removed grit & contaminants getting embedded in the case of
spot blasted surface. Eco Pickled Metal Surface (EPMS) processing always beats acid pickling, while spot blasting does not.

Eco pickled metal surface (EPMS) processing also shape & correct material through tension leveling. Tremendous pulling forces are generated between the entry-side waves - even mirror coil breaks.

Improperly prepared surfaces can result in reduced coating integrity and service life. Up to 80% of all coatings failures can be directly attributed to inadequate surface preparation, which affects coating adhesion.

To ensure adhesion of the coating to the substrate and prolong the service life of the coating system, select and implement the proper surface preparation. The method of surface preparation depends on the substrate, the environment, and the expected life of the coating system.

New galvanized metal, a product used to make corrugated sheets, gutters, and downspouts, is usually smooth and is coated with either a layer of oil to prevent white rust or is passivated. Paint applied over this oily surface or clear passivator will peel quickly.

Alkyd/oil paints that are applied to galvanized metal will adhere initially, but will quickly fail. The zinc of the galvanizing will chemically react with the alkyd binder of the paint, creating a "soapy" film (saponification) on the galvanized metal and causing the coating to peel.
When unpainted galvanized metal is exposed to the atmosphere and allowed to weather without being painted and is exposed to the atmosphere, the protective zinc coating will oxidize into a white rust until eventually the zinc metal is depleted. The underlying steel will then rust, which must be removed to ensure good adhesion of the coating. Wire brushing or scrubbing with a stiff brush or cylindrical abrasive roll is recommended to remove the white rust.

The present invention is described with greater specific and clarity with reference to following drawings:

Fig-1 represents the top view of the present invented method of mild steel and stainless steel material to remove mill scale and rust.

As shown in Fig.1, the present invented whole process is divided into the different zone. The said process is either continuous or modular and can be extended to fulfill the customize requirements.

- Sheet loading
- Degreasing zone
- Top side Brushing zone
- Bottom side Brushing zone
- Washing zone
- Cold Air Blowing zone
- Hot Air Evaporation Zone
- Coating & Squeezing zone
- Sheet Unloading zone
As shown in Fig.1, the schematic view of the apparatus of the invention that is used to perform the method of the invention to remove the scale from the surface of processed sheet metal. In the sheet metal loading zone(1), first the metal sheets lode on the machine, where the feed rollers are provided to transmit the metal sheet at degreasing rinsing zone(2), where high pressure hot water jet flow is rinsing from top and bottom side provided on the degreasing zone (2) for degreasing the sheet metal. In this zone, dust & oil particle which might be available on metal surface are started to release and water is entered into the water filter where the water is filtered and stored into the tank for the further reuse. In this degreasing zone (2) oil and dust particles are also separated and stored into different storage and water will be reused after online filtration operation. Then the metal sheet further transmits at top brushing zone (3) to scrub the top surface of the metal. The level of the brush can be adjusted according to the thickness & width of sheet metal. Then the sheet metal entered at bottom brushing zone (4), where the bottom side surface is scrub. In the top and bottom brushing zone (3 &4 ), some loose and sticky surface particles, which was not cleaned in degreasing rinsing zone are cleaned and metal sheet is transmit for further process.

In the brushing zone (3 & 4 ) water is recycled with filtration system. During the brushing operation removed rust, dust and other residue and particle transfer to filtration system in slurry form. In filtration zone water will be reused for washing zone and waste will be collect in storage chambers, and all process are an environment free. After brushing and scrubbing on both side sheet transfer to the washing
zone(5) to rewash & clean the scrub metal particles from the top and bottom side. After rewashing of metal surface excess water will be removed with the sharp edge cold air jet blow pressure to wipe the water from the sheet metal into cold air blowing zone(6). Now the metal sheet is transmit into the hot air evaporation zone(7), where the remaining water particles and moisture is evaporated by applying hot air from the top and bottom side with the temp. of 80 to 120 degree. Now sheet is 100% free from scale, rust and oxide with mechanical process. In the last zone, as per the customize requirement the sheet metal is entered into the coating and squeezing zone(8) where the sheet metal is coated with oil, colours, PVC coating and any other coating process as per the customize requirement. Then the sheet is unloaded for the further application into sheet unloading zone (9).

The present invented novel method EPMS (Eco pickled metal surface) of mild and stainless steel material to remove mill scale and rust. The present invented method has following advantages.

**Advantages.**

- Delay rusting process time on mild steel  
- Better surface finish  
- Consistent cleaning effect  
- No disposal restriction for hazardous waste  
- Eco friendly Environment  
- Faster production line  
- Reduce Labour and production cost
The present invention is having following advantages in Industries

Paint Shop
- superior paint finish, consideration to more uniform surface texture
- superior corrosion performance
- eliminates hazardous acid wash solution
- Strong paint adhesion with good reflection

Weld shop
- no oil film to burn off - reducing welding fumes
- more stronger welds, with more uniform bead
before welding preparation not required (wiping, grinding)

Laser & plasma Cutting shop
- Clean, uniform surface reduces beam diffraction for smoother,
more uniform cutting

STAMPING
- Lubricants get directly to the steel (unimpeded by an oil film barrier) so it can perform optimally

Testing
- Paint tests have determined the curing, adhesion, corrosion resistance (salt fog exposure testing) meet industry standards

Rollforming and tube production
- Roll tooling slips less when there's no oil film
- Great shape + clean surface=better seam weld
- No need to strip off or sandblast finished part or tubes
- Finished tubes and parts much less susceptible to rusting
We claim:

1. A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES consist with following steps:

   (a) first the metal sheets lode on the machine metal sheet loading zone(I),
   (b) the hot water is rinsing from top and bottom side to degreasing the sheet metal at degreasing zone(2),
   (c) dust & oil practical are started to release from the sheet metal at degreasing rinsing zone(2),
   (d) the metal sheet transmit at top brushing zone (3) to scrub the top surface of the metal by multi head brush station;
   (e) the metal sheet transmit at bottom brushing zone(4), to scrub the bottom surface of the metal by multi head brush station;
   (f) top and bottom surface scrubbing metal sheet, transmitted into the washing zone(5) to clean and rewash the scrubbed metal sheet from the top and bottom side;
   (g) the high pressure sharp edge cold air is blowing on the metal sheet to wipe the excess water from the sheet metal surface into high pressure cold air blowing zone(6);
   (h) the sheet metal transmitted into the hot air evaporation zone(7), where the remaining water particles and moisture is evaporated by applying high temperature hot air from the top and bottom side.
(i) the sheet metal is transmitted into the coating and squeezing zone(8) as per the customize requirement

(j) the sheet metal is unloaded for the further application into sheet unloading zone (9).

2. A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES as claimed in claim 1 wherein the metal rollers are provided into sheet loading zone (1) to transmit the metal sheet at degreasing zone(2).

3. A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES as claimed in claim 1 wherein the hot water flow is provided on degreasing zone (2) for rinsing hot water from top and bottom surface of the sheet metal.

4. A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES as claimed in claim 1 wherein the level of the brush can be adjusted according to the thickness & width of sheet metal into the top and bottom brushing zone.
5. A NOVEL METHOD FOR METAL SURFACE PREPARATION TO REMOVE MILL SCALE, RUST & RESIDUES as claimed in claim 1 and 4 substantially as herein described with reference to the foregoing description and the accompanying drawings.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

See extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: B08B17/18, 7/04, C23G3/30, B21B45/14, B21C43/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPDOC, WPI, CNPAT: air, gas, wind, blow+; water, liquid, flow, hot, warm, cold, dry+; dried, steel, metal, brush+

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C.

* Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report
08 Mar. 2012 (08.03.2012)

Name and mailing address of the ISA/CN
The State Intellectual Property Office, the P.R.China
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Facsimile No. 86-10-62019451

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Telephone No. (86-10)62085390

Form PCT/ISA /210 (second sheet) (July 2009)
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Continuation of second sheet: A. CLASSIFICATION OF SUBJECT MATTER

C23G3/02 (2006.01) i

B08B7/04 (2006.01) i