WIPING OF OILS AND EMULSION FROM STEEL STRIP IN COLD ROLLING MILLS

INTRODUCTION

In the cold rolling process, the surface of the rolled strip is contaminated by cooling oil or emulsion and other pollutants that could considerably influence the final quality of the strip. Unfortunately, this will usually become visible only after subsequent operations such as annealing, galvanising, phosphate or powder coating, etc.

Rolled strip is coiled at the exit end into coils containing all these gathered impurities and cooling emulsion and thus losing valuable rolling emulsion which could probably be used again – provided we have a means to remove it before coiling.

For a high quality of rolled material it is necessary that besides the final geometrical shape and thickness tolerance of the strip, the surface be clean.

Present cleaning methods used

Removal of cooling emulsions or oils from the rolled strip in rolling mills is presently done with the help of rag squeegees or sewn textile parts which quickly absorb oils and/or emulsions, rendering inefficient in a very short time.

In addition, the release of textile fibre usually contributes to the soiling of the strip and subsequent strip quality problems after the final operations (for example, the well-known scratch marks on the surface!). A further disadvantage is the lost of pulling power of the coiler due to increased friction between the “rag squeegee scraper” and the rolled strip.

Another method is wiping (blowing off) by high air pressure blowing directly onto the strip. This method cleans the strip surface impurities only partially and due to the high air consumption is not widely used.

Yet another method uses “scraping rolls”. Here the final result is dependent on the surfaces of rolled strip and scraping rolls, which could lead to impurities stuck on the roll’s surface further damaging the strip. Speed of rolling, strip flatness and strip thickness are also very important parameters that must be taken into consideration.

More recently devised methods use differently shaped plastic squeegees in combination with suction of emulsion, which appear to be more effective. However, their fastening devices prevent flexibility and its adaptation to the running strip, rendering this method prone to fast abrasion of the plastic slats and insufficient wiping action.

Wiping equipment of UVB TECHNIK Company

Company UVB TECHNIK devised new equipment incorporating all the positive features mentioned above. For the strip cleaning / wiping action they use two pairs of opposite, interchangeable “wiping slats” fastened in sliding holders. These are subsequently held in “floating frames” enabling the adaption of the positioning, elevation and inclination of the slats to the movement of the rolled strip, reducing the “holding” (press down power), thus increasing the working life of slats and minimising the surface damage.

For the adherence of the slats to the moving strip, a pair of side pneumatic cylinders is used with continuous, step-less regulation of the closing force. This method makes it possible to set up the residual quantity of the cooling emulsion on the strip. Furthermore, careful adjustment of the “hold-down pressure” increases the slats´ working life without impairing the efficiency of the rolled strip wiping function. An important part of the whole mechanism is pressurized air blow, via jets positioned between the wiping slats. This also speeds up the drying of the rolled strip.

The principle of “pressurized air blow off” is based on the creation of air overpressure between the first and second “wiper slats” restricting oil or emulsion penetration where there is lower adhesion of wiping slats to the whole strip cross-section, thus enabling correct emulsion / oil removal even at lower slats adhesion. First slat (in the direction of moving strip) provides rough wiping of the cooling liquid and the second secures clean wipe and closes the space for supplied air overpressure (see Fig. 1).

UVB TECHNIK s. r. o. Hlučín, Ostravská 79A , CZ 748 01 Hlučín , tel.:+420 595044444, fax:+420595044700, e-mail: sales@uvbtechnik.cz, www.uvbtechnik.cz

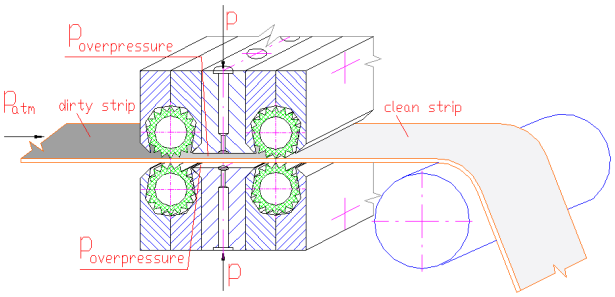


Fig. 1: Detailed view of the space between the wiping slats

This air overpressure in the space between the wiping slats also minimizes slat wear and restricts penetration of surface impurities.

For the correct functioning of this "Wiping Equipment" is necessary to have supply of 4 to 6 bars (PN6 of pressurized air). Part of our "Wiping Equipment" unit is an air unit enabling the connection of this outfit to normal pressurized air supply in the client's company.

Maintenance is straightforward - all that is necessary, is a regular change or partial turn of the wiping slats (Fig. 9). The complete slat holder is pulled to one side while the strip motion is stopped and both wiping slats are replaced by new once. Fig. 2 depicts the side movement of the slats holders at the regular change of the used plastic wipers. There should therefore be sufficient space on the left for the operating crew engaged in changing the holders incorporating the wiping slats. The opposite (right) side holds the air pressure piping for movement of the pneumatic cylinders and pressurised air for the jet blowers.

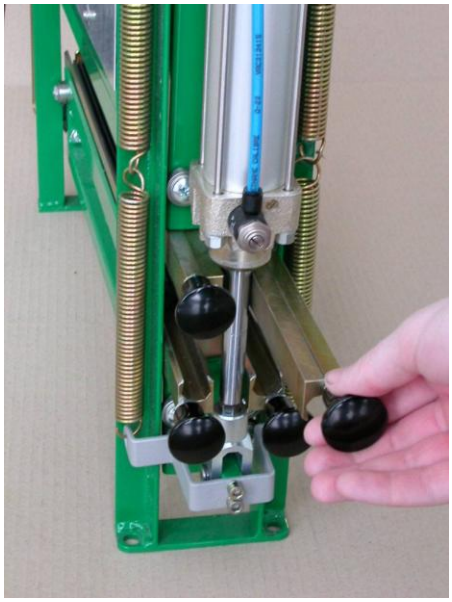


Fig. 2: Side movement of slat holder while the slats are changed

Fig. 3 we can see a general depiction of the wiping equipment with main dimensions, where D is width of the strip.

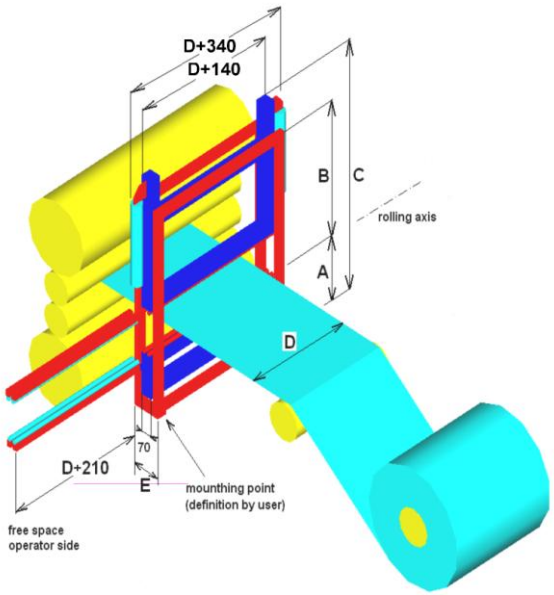


Fig. 3: Essential dimension of wiping equipment

The following pictures show the wiping equipment SZ 500 used for cleaning of the rolled strip from steel strips with width up to 450 mm (Fig. 4).

Fig. 4: Total view of wiping equipment SZ 500

This equipment was used for testing with results presented. Fig. 5 depicts clean rolled strip exiting wiping equipment.

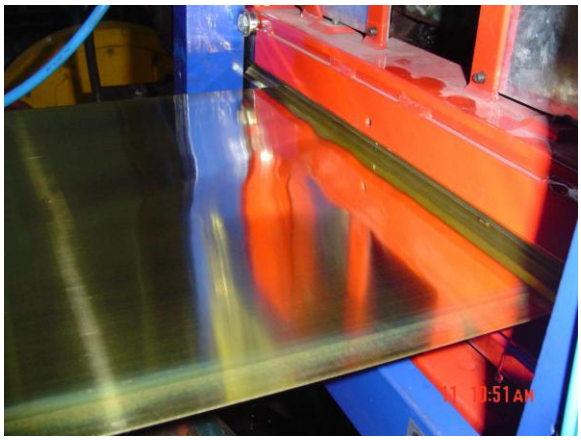


Fig. 5: Rolled strip exiting the wiping equipment

Wiping slats

The most important part of the wiping equipment is the wiping slat. Its task is to mechanically wipe all residuals, emulsions and oils from the rolled strip surface.

The advantage of the profiles is that worn teeth can be replaced by "new ones" simply by turning the slats. By correct turning, the wiping slat can be used two times (turn by 180 degrees).

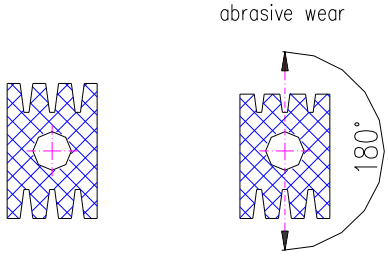


Fig. 6: Basic shape of wiping slats
- turning after "side wear".

Wiping slat materials have increased temperature resistance due to the pressurized air introduced between the parallel slats (Table 1). Although a temperature of 100 degrees C is rather low in the rolling mills environment, the wiping slats from PVC and SBR are designed (and practically tested) with the best wear off resistance at these temperatures. Temperature resistance of these materials is more than sufficient if used at galvanizing, powder coating, parting, trimming and levelling lines.

Material	PVC	SBR	PUR
Temperature resistance	Up to 100° C	Up to 100° C	Up to 150° C

Table 1: Comparison table of material temperature resistance.

Basic technical parameters of the Wiping Equipment

Rolled strip width	max. 2000 mm
Rolled strip speed	unrestricted
Rolled strip temperature	up to 150° C
Rolled strip thickness	max. 10 mm

Main advantages of the Wiping Equipment

- Better quality of rolled strip after cold rolling without spots of residual used oil or emulsion, threads of wiping rags and felts
- Possibility of higher rolling speed
- Non-slipping of pulling rolls when used in parting, trimming and levelling lines
- Reduced possibility of strip floating (telescopic action) while coiling
- Non-existence of "burned oil spots" after annealing
- Lower annealing times
- Substantially increased service life of degreasing agents in cleaning lines
- Lower expenditures of consumables
- Ecological advantages

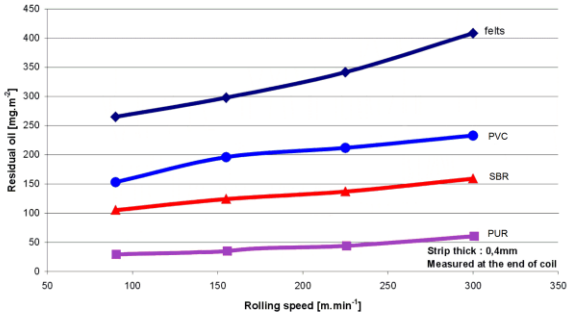
Fig. 7: Wiping equipment on the cut to length line

Ecological advantage of the Wiping Equipment

This equipment offers the solution of the problems associated with the use of rags and felts most commonly used for strip cleaning. The disadvantages of these materials, besides the release of threads and pieces of the material substances are very frequent changes and/or replacement of the oil / emulsion soaked parts. From an ecological point of view the new Wiping Equipment has the following advantages:

- Waste elimination of used oil / emulsion soaked material parts
- Decrease in rolling oil and/or emulsion consumption due to improved collection immediately after the last rolling stand
- Taking into consideration the existence of correct “oil saving policy” the rolling liquids can be collected, cleaned and subsequently reclaimed
- Elimination of dangerous fumes in the annealing process due to the absence of rolling oil between the coiled wraps
- Substantial decrease, even elimination of ecologically dangerous degreasing agents in cleaning lines
- Ecologically friendly recycling of plastic materials used in the wiping slats

Graph 1 shows a comparison of the residual oil after the strip cleaning with wiping equipment SZ 500. Width of the particular strip was 400 mm and thickness 0.4 mm. Firstly, we measured the residual oil after cleaning / wiping of the strip with felt textile slats, and compared the results with those obtained by using slats made from SBR, PVC and PUR. After stopping the rolling mill an absorption paper was applied to the middle of the strip, left for one minute and absorbed oil was weighted on an analytical weight scale instrument. The difference in weight before and after “oil absorption” is plotted in the graph. Measurements were done for four different speeds of rolling – approximately for 90; 155; 225 and 300 metres per minute.



Graph 1: Comparison of residual oil quantity using different wiping methods and rolling speeds.

CONCLUSION

From the presented graphical results it is apparent that the thermal polyurethane is the most effective from all four presented materials and wiping methods. Comparison with the other materials shows its ideal hardness, allowing sufficient adherence to the running strip. Its excellent abradability and thermal resistance allows the wiping slats to change (partially turn) only after 1 or 2 8-hour shifts. Combination of this material and the wiping equipment described above results in the best solution of impurities and rolling residuals cleaning after the strip rolling process.

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