COIL TO BAR PEELING PROCESS FOR AN EFFICIENT VERTICALIZATION OF SMALL DIAMETER QUALITY PRODUCTS[1]

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Abstract
Our paper introduces the advantages of production of peeled bars from hot rolled coils. Coil to bar peeling allows to optimize the processing in the rolling mill increasing yearly production and global process yield. The proposed technology will also reduce the peeling processing cost due to several advantages like minimization of the metal removed and reducing handling procedures.
Key words: Peeling; Coil to bar; Optimization; Cost reduction.

PROCESSO DE DESCASCAMENTO DE BARRAS PARA UMA VERTICALIZAÇÃO MAIS EFICIENTE E DE QUALIDADE EM BARRAS DE PEQUENOS DIÂMETROS

Resumo
Nosso trabaho introduz as vantagens oriundas do processo de descascamento de barras a quente.O descascamento de barras permite aperfeiçoar o processamento no laminador, aumentando a produção anual e o rendimento em âmbito global. A tecnologia proposta busca reduzir o custo no processo de descascamento devido a várias vantagens como a diminuição do metal removido e a redução dos custos com manuseio.
Palavras-chave: Descascamento; Bobina para barra; Otimização; Redução de custos.

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CONCEPT OF “VERTICAL” OPTIMIZATION OF THE PROCESS

Mair Research with the following technical solution allows to have a vertical optimization of the process.
It means that with a cold processing solution we can improve the efficiency of the hot rolling mill and consecutively reduce the production cost either in hot rolling and peeling process for the production of bars up to 60 mm diameter.
Having a global process vision is a must for Mair Research and is a way to find out solutions which makes the final user more competitive.

PRODUCTIVITY ADVANTAGES WITH BARS IN COIL ROLLING

The global vision of the production process begins with the rolling cycle: the vertical optimization of the process should be considered not only in the single peeling procedure.
With the advantages offered by the coil bar rolling, the efficiency of the rolling mill increase taking advantage of:

- Reduction of crop cuts due to rolling mill discard: thanks to the production of bars in coil, the only crop cuts are the ones in the rolling mill.
  No head and tail discards, as well as short bars due to cutting operation at the exit of the cooling bed, are produced.
- Higher production speeds – according to steel grades - thanks to Garrett coilers and consecutively increased hourly production output of the rolling mill with an optimization of the re-heating furnace.

In this way up to 10% reduction in the process costs is achieved.

COMPARISON BETWEEN BAR TO BAR AND COIL TO BAR PROCESS ON SMALL DIAMETER BAR PEELING

Bar-to-bar peeling process is the well known and common one, undoubtedly, the only one possible for large diameter bars and bars which cannot be coiled.
But processing small diameters (below 35 mm) in bar to bar process have the following limits which can be easily settled in the coil to bar process:

- Bar leading ends and trailing ends could affect the process speed; the cutting quality should be the best one in order to have an uninterrupted and stable contact between the bar being processed and the next one, this to lower vibrations.
  This is not always possible with the bars coming from rolling mills, in fact, bars with shear cutting has not the requested perpendicularity to guarantee a stable contact between the bars, this oblige to reduce the processing speed of the peeling process.
  Coil-bar process is not affected by this type of problem, since effectively only one bar is being handled.
- A very precise guiding system, close to the peeling head, is required due to the small dia. bar flexibility and in order to have the least possible unguided bar portion. In the coil-bar process the bar are always between the inlet guide and the outlet guide and no vibrations could be experienced.
- In bar to bar process the material tolerances are the ones obtained from a hot rolling process (DIN standards or better), it means that size tolerance and ovality/triangularity should be considered, it is therefore needed to provide a higher metal removal on the material with consequent increased quantity of rejected material in chips.

In coil to bar processing the material is fed into a cold rolling head which guarantee to obtain material with very good tolerances in terms of form and diameter.
In this way the removal of material is reduced to a minimum level, in order to optimize the efficiency and guarantee the removal homogeneity as well as the triangularity of the peeled material.

BASIC PROCESS DESCRIPTION

Coil to bar peeling process (Figure 1) is composed by a combined action of several machines as explained here following:

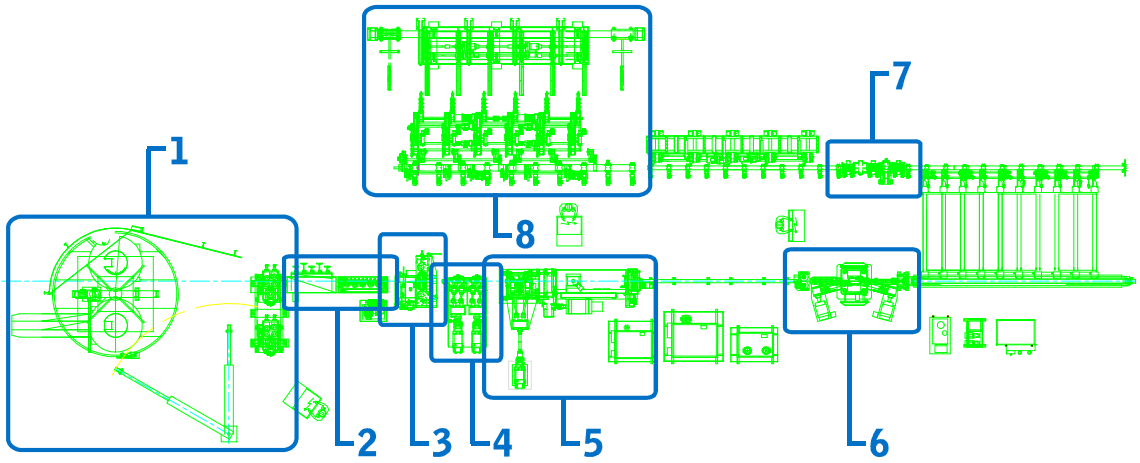

Figure 1

1 COIL OPENING AND HEAD FEELING

Coil opening area is composed by a double vertical decoiler (Figure 2) with tiltable arms able to receive coils from overhead crane or fork lifts.
The coil opening procedure is performed by a robotic arm (Figure 3) hydraulically driven and controlled from the control pulpit by the operator.
Once detected the coil head the arm transport it to the movable pinch roll that will feed it into the line.

Figure 2

Figure 3

2 – WIRE STRAIGHTENING

Once feed the wire into the line the first operation is performed by a vertical and horizontal axis straightening machine.
Multiroll straightener (Figure 4) is provided by 9 + 9 rolls which guarantee a proper straighteness before the cold rolling stand.
The straightening heads are specially designed in order to collect the scale loosed during straightening process.

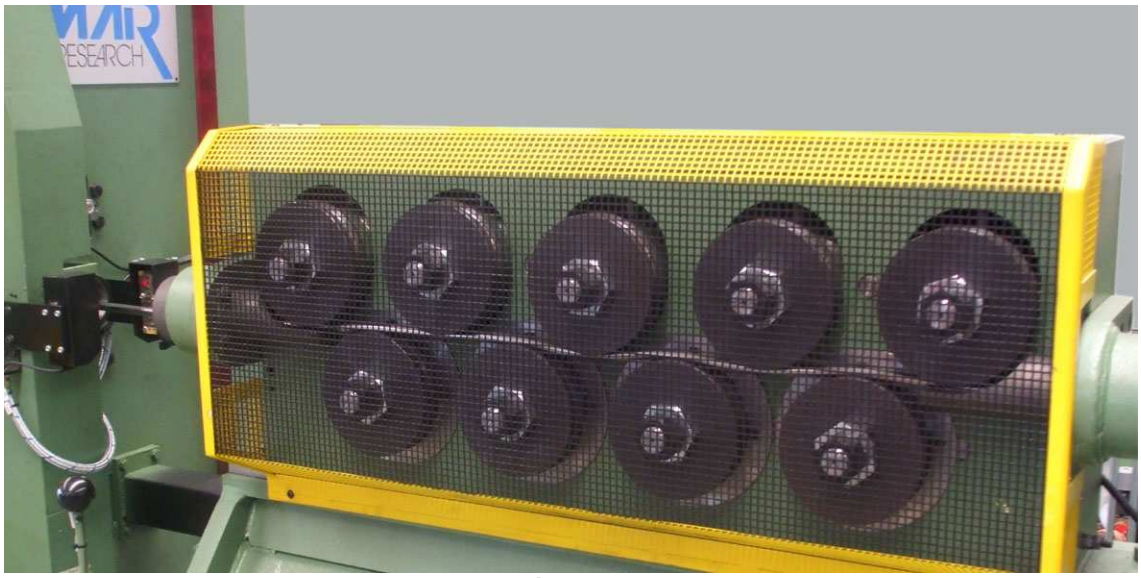

Figure 4

3 – COLD ROLLING HEAD

The straightened wire pass trough a double calibrating head (Figure 5) composed by two horizontal axis rolls and two vertical axis roll.
Cold rolling head has a double function in the integrated process, compress material in order to eliminate the memory form and correct the form and size tolerance of the rolled material

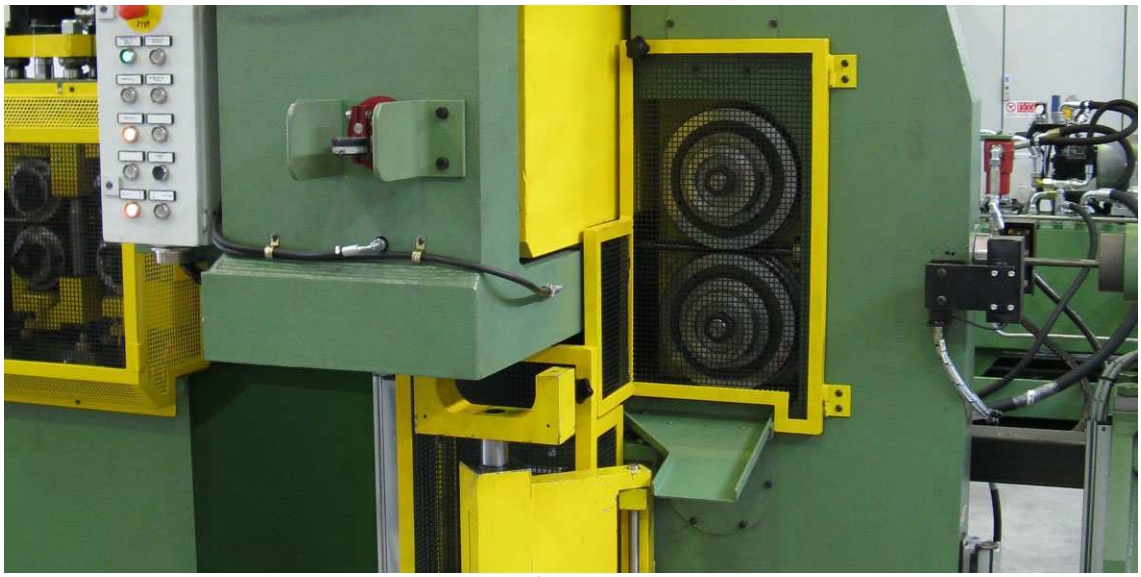

Figure 5

4 – SKEWED-ROLLS PINCH ROLLS

The function of the skewed-rolls pinch roll (Figure 6) is to feed the material into the peeling head In torsion, this allow to improve the straightness on the peeled material allowing to process also material with strong memory form like spring steels.

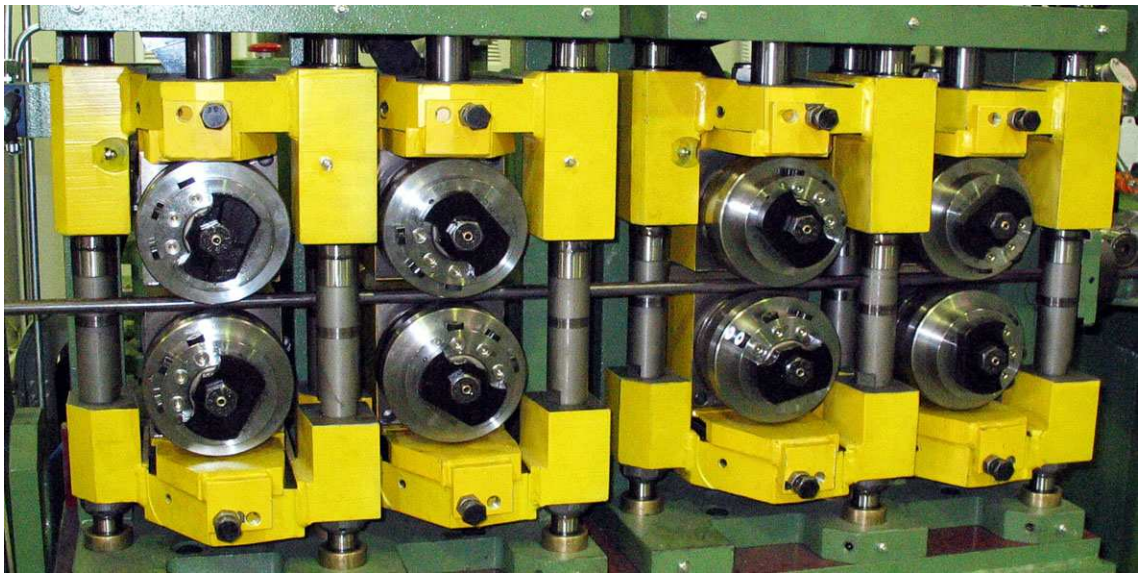

Figure 6

5 – PEELING MACHINE

The peeling machine (Figure 7) integrated in line is a machine composed by the following groups:

Figure 7

- Feeding group it is composed by two skewed-rolls pinch roll (Figure 8) to feed the material into the machine and a feeding speed control system which act directly on the material in order to control the effective material feeding speed.

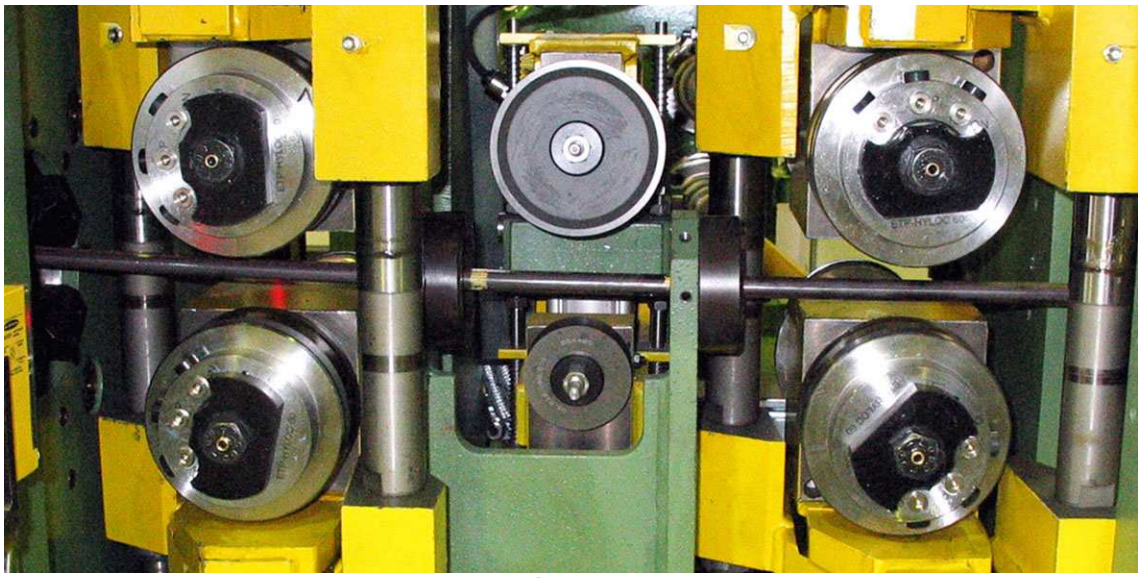

Figure 8

- Entry guiding group unit composed by 4 double rolls (Figure 9) positioned at 90° one each other in order to keep the material on the machine working axis. The positioning of the rolls is automatically controlled by Automation. Entry guiding group and feeding group are mounted on the same structure which slides in a longitudinal way allowing to perform the tool changing at any time even with the material in the machine

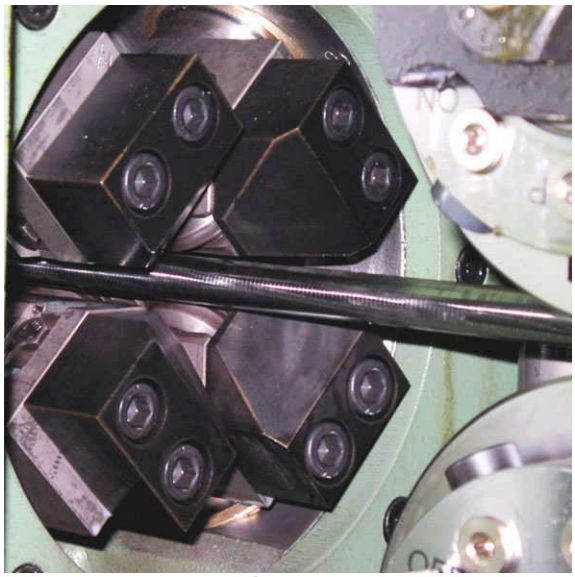

Figure 9

- Peeling head (Figure 10) composed by a radial group fixed on the hollow shaft driver by an electric motor and gearbox.
  Peeling head is complete with tool regulation system able to correct continuously the position of the tools in accordance with the laser diameter control placed on the peeling machine exit side. During the peeling process a flow of emulsion is sprayed on the tools and material in order to cool down them and allow an easier chip evacuation. Keeping a low temperature tool life increase reducing the production costs of the process. Mair peeling head thanks to a state of art control of the tool positioning has the capability to produce standard bars (cylindrical peeling) or By-conical bars needed to generate mainly tapered springs.

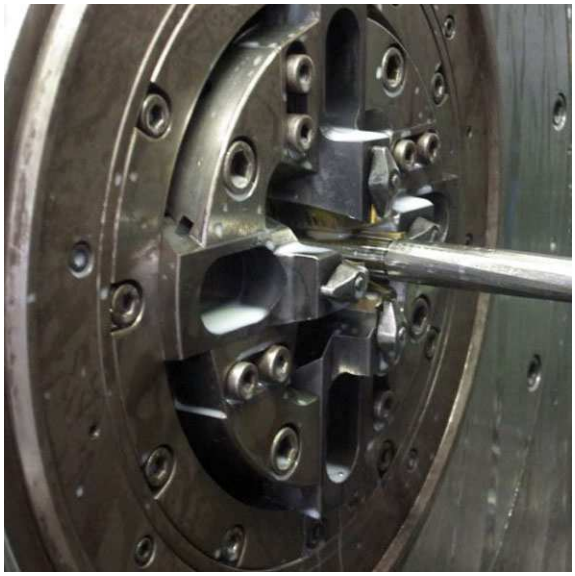

Figure 10

- Exit guide (Figure 11) installed on the exit side of the peeling head has the function to keep the bar on the machine working axis, it is composed by set of rolls placet at 120° one each other.
  Rolls positioning it is automatically controlled by the software

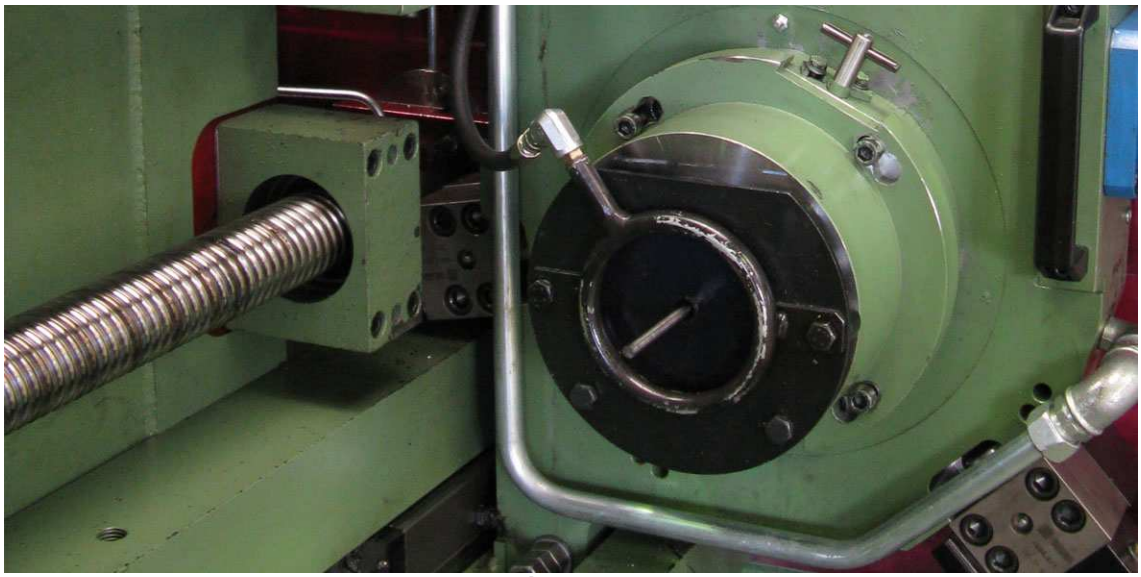

Figure 11

- Exit carriage (Figure 12) slides on linear guides and it is driver by a ball-bearing screw.
  On the carriage a flying shear it is installed in order to cut the wire in bars of pre set length.

Figure 12

6 – TWO ROLL STRAIGHTENING AND POLISHING MACHINE

It is installed in order to finally improve straightness and roughtness of the material.
The connection between the peeler and the straightener could be direct thanks to a conveying channel or by a transferring bench, in accordance with the clients needs.
Straightening and polishing machine (Figure 13) is designed in order to be able to process all the products that could be produced by the peeler, means cylindrical and by-conical bars too.

Figure 13

7 – ONCE STRAIGHTENED THE BARS COULD PASS TROUGH FURTHER PROCESSING

like chamfering, non destructive testing, abrasive polishing, etc. in accordance with the final user needs

8 – AT THE END OF THE LINE AN AUTOMATIC OR SEMI AUTOMATIC BUNDLING UNIT (FIGURE 14) COULD BE INSTALLED

in order to allow an accurate bundle preparation avoiding scratches and damages on the finished bar surface.

Figure 14

RESULTS

This process gives important advantages on the peeled bar production:

- Optimization of the hot rolling process with benefits on the rolling mill.
- Reduction of the metal removal on the bar increasing the material yield.
- Increase tool life.
- Complete in-line process without any intermediate storage area.
- Modular process that could be connected with non destructive tests, chamfering, bundling…
- High output of prime quality material (peeling feeding speed up to 60 mpm).
- Fully automated line and smart lay-out solutions allow a single operator to manage the complete process.