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New Filter Selection, Installation, Commissioning and Operation at CBI Concentrator

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ABSTRACT: The Çayeli concentrator designed nameplate capacity was 600,000 tonnes per year. Originally, three Rittershaus & Blecher pressure filters were installed: one for copper concentrate, one for zinc concentrate, and one standby for both copper and zinc concentrates. Mill throughput gradually increased after commissioning and was 896,700 tonnes in 1999. At these production levels, the filtration capacity created a bottleneck. In 1999, CBI decided to increase the mill capacity to one million tonnes per year and a fourth filter was installed İn the year 2000 as part of the expansion plan. A LASTA M.C. automatic filter press was selected. This paper describes the selection, installation, commissioning, and operation of the new filter; and compares its performance with that of the old filters.

1 INTRODUCTION

Çayeli Bakir isletmeleri is a copper zinc mine at Çayeli on the eastern Black Sea coast in the province of Rize. The mine is located 7km from the coast. It is an underground operation of one million tonnes per year, producing copper and zinc concentrates. The concentrates are trucked 25 km to a port facility at Rize for shipment to customers.

2 SELECTION PROCEDURE

Originally, the ÇBI mill was equipped with 3 Rittershaus & Blecher (R&B) pressure filters. These filters are high-maintenance items and required dedicated mechanics to look after them as production increased. Initially, one operator was budgeted for the dewatering section, but due to the operational difficulties of these filters, this was increased to two operators per shift. In choosing a filter, the main selection criteria were low maintenance and operation costs, and the filter had to be simple to operate and robust m design. The capacity requirement was 400 dmt/day.

Quotations were requested from the Larox, Outokumpu, Bethlehem, and MC LASTA pressure filter manufacturers.

After preliminary evaluation of the quotations, a trip to North America was arranged so that these filters could be seen in operation and first hand information about their performance could be obtained.

Larox filters were observed in the Louvicourt and New Brunswick mines in Canada. The filters in Louvicourt were being used for filtering copper and zinc concentrates and the one in New Brunswick was being used for copper concentrate.

A Bethlehem filter was examined at Mason Metals, Chicago, USA. This filter is similar to the Larox. The material filtered was tin hydroxide slurry.

The MC LASTA filter was inspected at Kennecott Utah Copper, Salt Lake City, USA.

The Outokumpu Ceramec filter was rejected in the preliminary evaluation due to the high capital cost.

After the trip, a spreadsheet was prepared to compare the three selected bids for final evaluation based on our selection criteria.

The MC LASTA AUTOMATIC FILTER PRESS was selected. Industrial Process Machinery (IPM) offered a model MCFHC 1500 X 40/34 for 400 dmt/day operation. The number of plates offered was 34, while the frame capacity was 40 plates,

During discussions with the supplier, 6 more plates were added in order to utilise the maximum capacity of the machine. The nominal capacity with 40 plates is 470 dmt/day.

3 ENGINEERING AND INSTALLATION

The engineering contract was awarded to Foster Wheeler Bimas (FWB). The filter was a retrofit in place of two pilot-scale disc filters, which presented

an engineering challenge FWB completed the detailed engineering for the installation, including filter auxiliaries, İn two months. The auxiliaries were:

- one high pressure water pump for filter cloth washing, feed core clean-up, channel cleans, etc.,
- one slurry feed pump, which was also retrofit to the existing copper concentrate holding tank,
- one compressor, dedicated for use with the Lasta filter,
- one transfer pump, to pump filtrate and filter cloth washings.

FWB also prepared bid packages and helped in the selection of the contractor. EPRO Construction was awarded the project based on the CBI competitive bidding process.

The scope of the contract included all civil, steel, electrical and instrumentation works. A site project superintendent was appointed from FWB to supervise the contractor and to ensure that the construction was done according to their design.
The construction contract was awarded in mid-April and commissioning of the filter started in mid-August 2000. The filter was fully commissioned by the end of September 2000. The cooperation from 1PM during all phases of engineering and construction was excellent. One person from IPM was on site during erection and two persons were on site for commissioning. They programmed the PLC and checked that the filter operation was satisfactory. They trained the ÇBI operation and maintenance staff. The training sessions were well conducted and covered m detail all the finer points of operation and maintenance of MC LASTA filters. These points were found to be very beneficial, ensuring smooth commissioning and trouble-free operation of the filter.

4 COMMISSIONING

After the usual pre-commissioning checks and dry runs, hot commissioning of the filter started on 19 August 2000. The filter exceeded its rated capacity after one month of operation. The current operational parameters are as follows:
Average Cycle Time: 11 minutes.
Average Number of Cycles: 120 per day.
Average Capacity: 518 dmt/day.
The filter is consistently exceeding its rated capacity of 470 dmt and we are very satisfied with its performance.

5 OPERATION

The filter press has a fully automated cycle and does not have to be restarted after each cycle.

The press has three operational modes.

1. Manual Mode (Maintenance Mode).
2. Semi Auto Mode.
3. Auto Mode (Operation Mode).

5.1 *Manual Mode*

All functions are manually controlled. This mode is also called the maintenance mode and is required during maintenance.

5.2 Semi Auto Mode

The press operates and stops at the end of each phase of operation and requires restarting after each phase. This mode is used to optimise the operating conditions, especially during commissioning.

5.3 *Auto Mode*

The filter is started by simply pressing the start button and it completes a full cycle automatically. It does not need restarting at the end of each cycle. It stops only when the "feed tank empty" alarm is activated.

6 COMPARISON OF THE MC LASTA WITH R&B PRESSES ACCORDING TO OUR EXPERIENCE

6.1 *Performance Comparison*

6.1.1. Capacity (Number of Cycles)

R&B filters: The rated capacities are 390 dmt/day for copper and 330 dmt/day for the zinc filters. The average cycle time is 20-25 minutes This is highly dependent on cake discharge. The filling, membrane squeezing and cake blow cycies take 12-15 minutes. Cake discharging takes about half of die time required for the rest of tie steps. The plate-shifting mechanism is a problem and the operator is required to complete the cake discharge and clean the plates.

The plate-shifting mechanism chain and connection pieces, shifting hook, and locking hook (pawl) stick and plates often do not move. Sometimes, due to these difficulties, it is only possible to average 40-50 cycles per day.

In actual operation, only about 280 dmt/day is obtained, based on availability due to operational problems which are explained below.

MC LASTA filter: The Lasta filter average cycle time including the cake discharge, is about 11 minutes. This goes down to as low as 10.5 minutes when the filter cloths are new and goes up to 12.5 mmutes as the cloths get older. There is no operator assistance required for discharging the cake, The average number of cycles per shift is 38-40. Forty

cycles per shift can be achieved without difficulty. This figure has been as high as 45 per shift. The average capacity is over 500 dmt/day.

6.1.2 *Labour Requirements*

R&B filters: ÇBI employs 2 operators per shift to operate these filters due to frequent cloth changes (average 2200 cycles for one set of cloth) and plate-moving problems. The seal surfaces on the sides of the plates and around the feed opening require continuous cleaning after each cycle due to the lack of an auto cloth wash provision. An auto cloth wash after each cycle is not possible with the existing design. This is explained in more detail İn the maintenance comparison section.

MC LASTA filter: The press requires no operator assistance during normal operation. Operator assistance is required only during alarm status or to change filter cloths. Cloth life is about 5000 cycles. Two sets of cloth have been changed to date. The first set was changed at 4500 cycles and the second at 5000 cycles.

6.1.3 *Difficulties in Plate Shifting*

R&B filters: The plates are hung on a rail with carriages. The carriages are equipped with hooks. There is a continuous running chain mechanism with shifter hooks attached. These shifter hooks catch the locking hooks (pawls) on the plate carriages and move the plates. This complex system causes frequent plate-shifting problems. This reduces the performance of the press. When plate-shifting problems start, the operator needs to climb on top of the filter to release the plates and maintenance assistance is required to change the damaged connection pieces.

MC LASTA filter: The Lasta filter plate-moving mechanism is very simple. The plates are located on two rails. There is a replaceable polyethylene wear pad attached to the plates and this acts as a cushion, making movement easier. The top parts of the rails are also replaceable. The top surface of the rails needs regular greasing and the shift operators on each shift do this. The rail surfaces are easily accessible.

The plates are connected to each other at 4 comers by a piece of chain. The head plate on the side of the cylinder acts as a drive head. When the cylinder opens, the plates pull each other, leaving space between plates which is the same as the length of the chain connecting the plates. This helps the discharge of the concentrates and ensures equal space between plates for effective washing of the cloth after cake discharge.

When the filter closes, the cylinder pushes the head plate in the opposite direction and the head plate pushes the rest of the plates, which sit freely on rails. The gap between the plates starts to close, first from the cylinder side, and it is progressively closed as the cylinder moves to the feed side.

6.1.4 *Vibration Bars for Cake Removal*

R&B filters: No vibration bars İn design.
MC LASTA filter: When cake sticks to the cloth, the cloth support bar İs depressed due to the weight of the sticky material and blocks the photo beam. This activates a vibration cycle and shakes all the plates from both sides. The vibration cycle is also an indication of possible cloth problems, i.e., holes, blinding, etc.

6.1.5 *Cake Discharge System*

R&B filters: The cake falls with its own weight by gravity, and there are no additional features to help discharge the cake.

MC LASTA filter: The weight of the cake on the cloth rapidly compresses the springs which support the cloth support bars. The bars come to a sudden stop, which creates a shear effect between the cake and the filter cloth. This helps removal of the cake from the filter cloth.

6.2 *Maintenance Comparison*

6.2.1 *Filter Plate Repairs*

R&B filters: These filters require extensive maintenance on the plates for several reasons.

The plates undergo continuous wear on the seal surfaces due to the lack of a good seal. This is due to the absence of an auto cloth wash after each cycle. The wear surfaces are repaired hy plastic welding and filling. After a while, this İs no longer possible and the whole plate is taken out and sent away for resurfacing.

The air entry and filtrate discharge ports are not replaceable wear items; they are part of the whole plate. Any wear at these critical points means wear on the plate itself.

Damage occurs on the membrane plates. The rubber membranes are attached to the membrane plates by insertion of the seahng ring into the channel provided on the peripheries of the plates. These channels are damaged by compression İn time and membranes cannot be inserted anymore.

In general, plate repair is a continuous process. The plates are collected on site when they cannot be repaired with plastic welding, and are sent to Germany for resurfacing. ÇBI is looking for a local workshop to repair these plates.

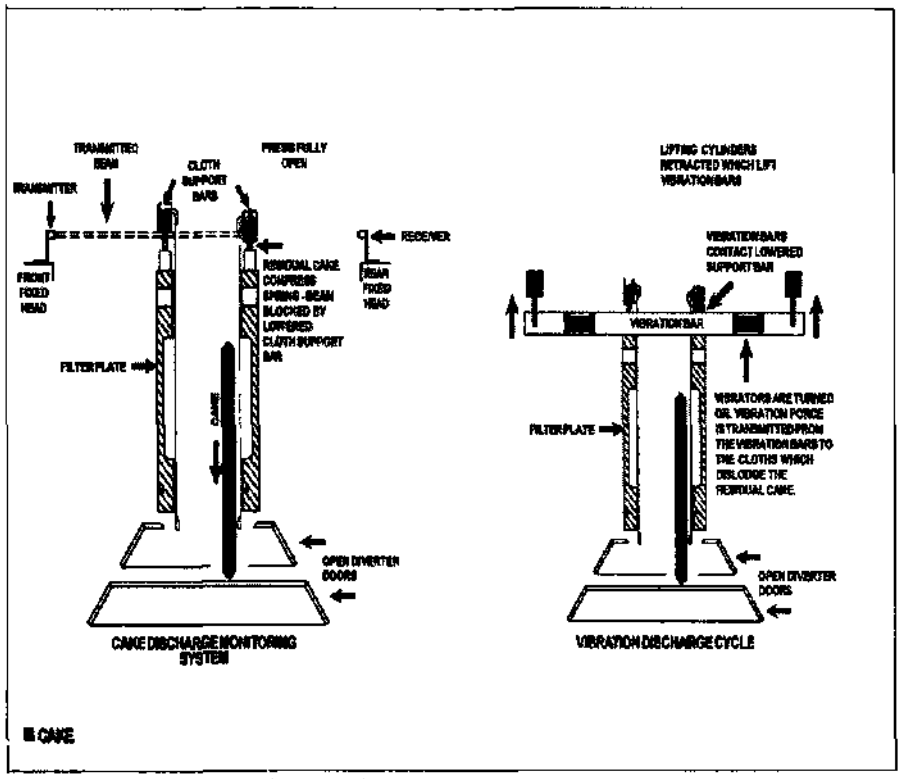

Figure 1. Vibration mechanism of MC Lasta filter

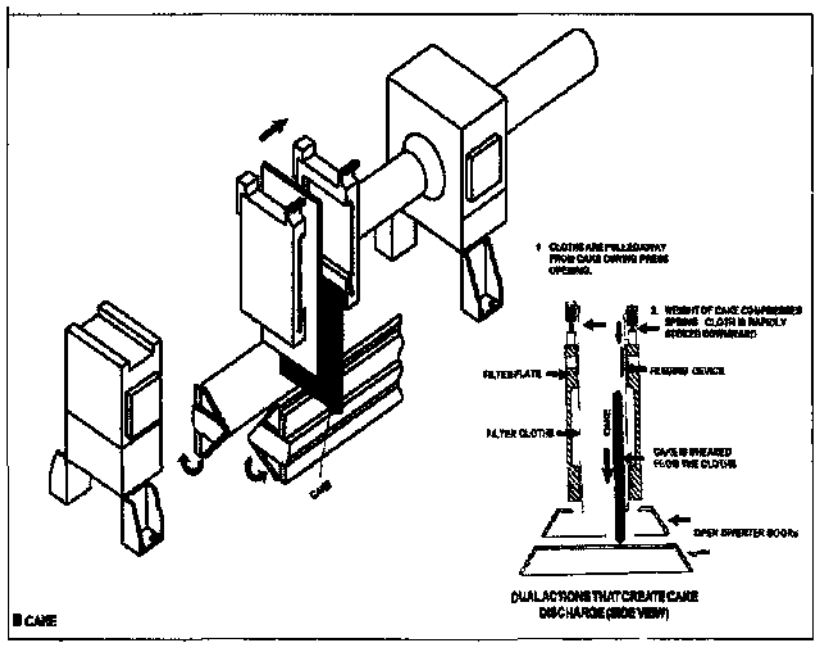

Figure 2. Cake Discharge of MC Lasta filter

MC LASTA filter: There are no membrane plates. Only chamber plates are provided. The air entry and filtrate discharge ports are replaceable units called filtrate rejecters. When worn, they are replaced. Their wear is also an indication of holes in the filter cloth.

To date, no plates have been damaged due to any other factors.

6.2.2 *Cloth Change Comparison*

R&B filters: The cloth is a single piece. Changing it is a time-consuming and fairly laborious job. One part of the cloth has to be rolled, squeezed and passed through the feed opening of the plate so that it can be put on the other side of the plate. Similarly, removing the old cloth is not easy as the cloth becomes harder and very difficult to roll back through the feed opening. It İs common practice to cut the cloth when removing it from the plates.

MC LASTA filter: The cloth change is very easy. There are two pieces, which are hung on each side of a plate by hanging bars. The filter cloth assembly can be prepared in advance of cloth change. The odd-numbered plate cloth is equipped with a feeding device which is attached to the cloth before it is hung on the bars.

6.2.3 *Plate-Moving and Shifting Mechanism*

R&B filters: The chains located inside the traverse are equipped with shifter hooks, which glide over the carriages of the plate pack when the press is closed. When the press is opened, one of the shifter hooks engages, due to its own weight, on the last plate and unlocks this plate. The shifter hook now moves the plate suspended from the carriage fitted with offset rollers. This action is repeated until the last plate is opened. The offset roller movement is hindered by dirt accumulating inside the traverse rails, which are difficult to reach and clean. If the locking hooks of the carriages are not caught by the shifter hook of the chain in the proper order, men a group of plates shift together. This overloads the locking hook and the drive motor of the chain mechanism. The locking hook bends or the chain drive motor trips due to overloading. In short, the plate-shifting mechanism is complex.

MC LASTA filter: The plate-moving mechanism is rather simple. The plates are connected to each other by chains at four corners. When the cylinder retracts, it moves the head plate backwards and the head plate pulls the rest of the plates one by one. The plates move freely on top of two side rails. The greasing of the rails makes it easy.

6.2.4 *Washing System Maintenance*

RifeB filters: The washing mechanism is a separate unit. It has a trolley with a moving chain and washing device. A geared motor is provided for the longitudinal and the wash travel drives. Both the washing device and the plates have to move to wash the cloth. The problems with plate moving continue during cloth washing. Each washing takes about 45 minutes if there are no problems with plate movements or washing device movements. The cloth wash is a manual process. The filter has to be stopped and the control unit is changed to cloth wash mode. It is not practical to wash cloth after each cycle since one wash takes 45 minutes.

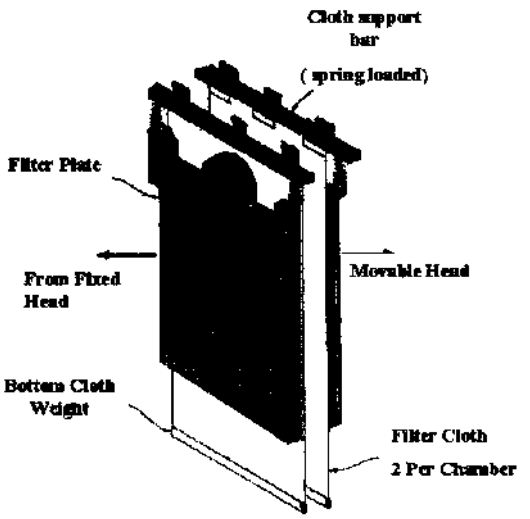

Figure 3. Filter cloth of MC Lasta

In addition to these problems, the washing device catches the filter cloth and sometime damages it while the sprays are in upward motion.

MC LASTA filter: The cloth wash is part of the auto cycle; it takes 40 seconds to wash all 41 plates and 40 chambers. Each plate is equipped with three cloth wash sprays as an integrated part of the cloth support bar. Water from the spray water header is connected to the cloth support bars on the even-numbered plates by hoses. Wash nozzles direct wash water over the cake side of the filter cloth.

6.3 *Safety and Environment*

6.3.1 *Leaks and Noise from Filter Plates*

R&B filters: Sealing surfaces deteriorate due to poor cloth washing, especially at the bottom of the plates. Cake remnants deteriorate the sealing surfaces. When the filter comes to the cake blow cycle, the compressed air leaks through these surfaces, creating dust and a shrill whistling noise. The cloth is also damaged by these surfaces.

MC LASTA filter: There is no sealing problem. The effective cloth-washing system after each cycle cleans all the surfaces of the plate. There are no leaks and there is no whistling.

6.3.2 *Position and Access to Plates*

R&B filters: The working platform is level with the bottom of the plates. This is necessary due to the operator assistance required in cake discharge. In order that the top of the plates can be reached, a ladder is provided. The operator or maintenance personnel have to put on a safety belt while working on top of the filter.

MC LASTA filter: The working platform İs located on top of the plates. The support rails, spray nozzles and cloth change bars are all accessible without the need for any safety equipment. One operator can change a filter cloth.

7 CONCLUSIONS

The selection of the MC LASTA filter was the right decision for Çayeli. The filter has exceeded our expectations. We recommend this filter for base metal concentrates where simplicity of operation and maintenance are key factors.

REFERENCES

Rittershaus & Blecher Filter Operation Manual
MC Lasta Filter Operation and Maintenance Manuals.