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Checking machine stops in the pressing station of beet sugar factories: Management and maintenance

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abstract

Increasing demand for pressed pulp with high dry substance content can cause very high workloads, especially on old presses which were designed for lower performances. The type of operation of the press and of the station can further stress these machines. With the aim of improving performances, as well, Babbini has recently remarkably increased the reliability of the critical components of its presses (gearbox and spindles). However, in order to completely avoid failures and machine stops it is necessary for the end-user to take some protective actions on several levels. Indeed, it is possible to avoid serious machine stops by ensuring that maintenance schedule (including ordinary, extraordinary and preventive maintenance) for press and gearbox is thoroughly followed, by periodically analysing and checking certain press working parameters, by making use of some protection systems (monitoring and control instruments). It is apparent that improved performance in a sugar factory is fostered by less machine stops.

Keywords: beet pulp presses, control systems, machine stops, maintenance, pressing performances, pressed pulp, presses reliability

Control de las interrupciones de la maquinaria en la estación de prensado de las fábricas de azúcar de remolacha. Gestión y mantenimiento

La demanda, en aumento, de pulpa prensada con alto contenido de sustancia seca puede producir muy alto volumen de trabajo, especialmente en prensas antiguas que estaban diseñadas para un desempeño menor. El tipo de operación de la prensa y de la estación puede exigir más aún a estas máquinas. Con el objeto de mejorar los desempeños Babbini también ha aumentado notablemente la confiabilidad de los componentes críticos de sus prensas (caja de engranajes y husillos). Para evitar completamente las fallas e interrupciones en el funcionamiento de máquinas es necesario, no obstante, que el usuario final tome algunas medidas de protección en varios niveles. Utilizando algunos sistemas de protección (instrumentos de monitoreo y control) en realidad es posible evitar paradas serias de las máquinas asegurando que el programa de mantenimiento (incluyendo mantenimiento ordinario, extraordinario y preventivo) para la caja de engranajes y los husillos sea exhaustivamente respetado mediante el análisis y la comprobación periódica de ciertos parámetros de trabajo de las prensas. Es evidente que disminuir las detenciones de las máquinas fomenta una mejora en el desempeño de una fábrica de azúcar.

Máquina de Verificação pára na estação de prensagem de usinas de açúcar de beterraba: gerenciamento e manutenção

Aumento da demanda por celulose pressionada com alto teor de matéria seca pode causar cargas de trabalho muito elevadas, especialmente em prensas antigas concebidas para desempenhos mais baixos. O tipo de operação da prensa e da estação pode enfatizar ainda mais estas máquinas. Com o objetivo de melhorar o desempenho, recentemente Babbini aumentou notavelmente a confiabilidade dos componentes críticos de suas prensas (caixa de velocidades e eixos). No entanto, para evitar completamente falhas e paradas de máquina é necessário que o usuário final tome alguns cuidados de proteção em diversos níveis. Na verdade, é possível evitar paradas de máquina grave, assegurando o que o cronograma de manutenção (incluindo manutenção ordinária, extraordinária e preventiva) na prensa e na caixa de velocidades seja cuidadosamente seguido periodicamente, analisando e verificando certos parâmetros de trabalho, fazendo uso de alguns sistemas de proteção (instrumentos de monitorização e controle). É evidente que melhorar o desempenho em uma usina de açúcar é promovido pelo mínimo de paradas de máquina.

Introduction

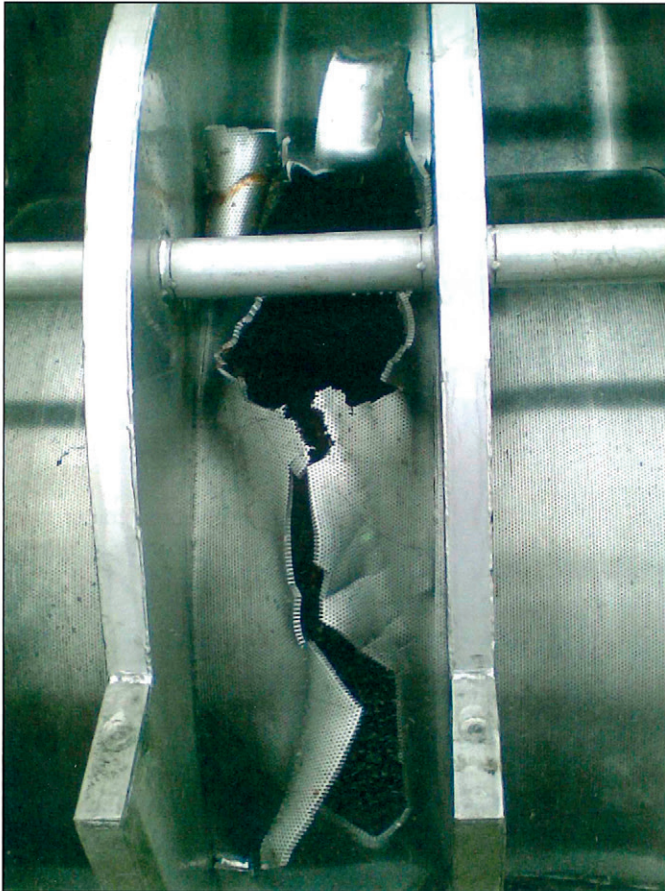
Babbini has been manufacturing presses for about 40 years. It has noticed a growing interest in the following aspects:

1. Beet pulp presses now play a more important role in the sugar manufacturing cycle in comparison of what they did in

the past thanks to the economic advantage coming from energy saving and from sugar and water recovery which the mechanical pressing allows.

2. The machine stops in the press stations, due to failures or simply to unforeseen events, often last longer time than in other departments of the sugar factory, and they can create big difficulties for the operation of the entire sugar factory.

Figure 1. Damage due to the entrance of a foreign object



Therefore it is very important, both for manufacturers and users, to adhere to the following inter-connected precepts:

1. To increase performances of presses, and
2. Increase the presses reliability.

Causes

Experience from sugar campaigns and analysis of the possible causes of the machine stops, suggests that both the presses manufacturers and the end-users should share the blame for having underestimated the problem. Breakdowns mainly occur as a result of stress underwent by the presses, mainly because of the following reasons:

- Increasing request for higher dry substance % in the pressed pulp

In the past, the required dry substance content was 22-24%. Nowadays, this has increased to over 30% for pulp which is sent to a drier (for pulp used for biogas production, there are different parameters).

- Machines subject to a high mechanical stress

The press screws are subject to stress which experience significant fatigue, growing exponentially with increasing workload from demand for higher dry substance content.

These mechanical stresses still further increases following an “unstable” managing of the press (continuous speed variations or discontinuous feeding) or of the process (extremely variable physical characteristics of the cosettes or anomalous additives quantities).

This poor management is also one of the possible causes for the reduction in the press performance.

- Insufficient maintenance

The general need for reducing sugar manufacturing costs leads to a reduction in particular in the expenses for maintenance.

- Poor monitoring
- Entrance of foreign bodies (see Figure 1)
- Presses installed in the open air

Remedies and solutions

A. Higher reliability of the critical parts of the press

In the course of the last few years, Babbini increased the reliability of its presses and in particular of its more critical component: the gearbox and the spindles.

The gearbox safety has been increased in order to make it more reliable, even under higher workloads.

Gearbox: Babbini today has its gearboxes manufactured by GPS, a consociated company which is part of the Cangialeoni Group, thus assuring higher quality to the final product thanks to the direct control, the possibility of a close and continuous cooperation with the gearbox manufacturer, the possibility of customizing the supply,

Figure 2. A GPS gearbox for a PB48Sp press with vibrations gear case and dehumidifier

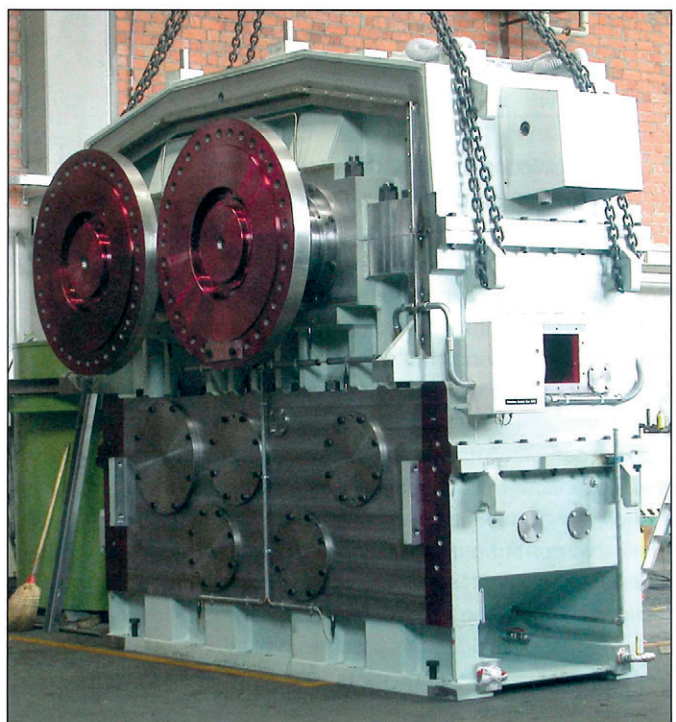
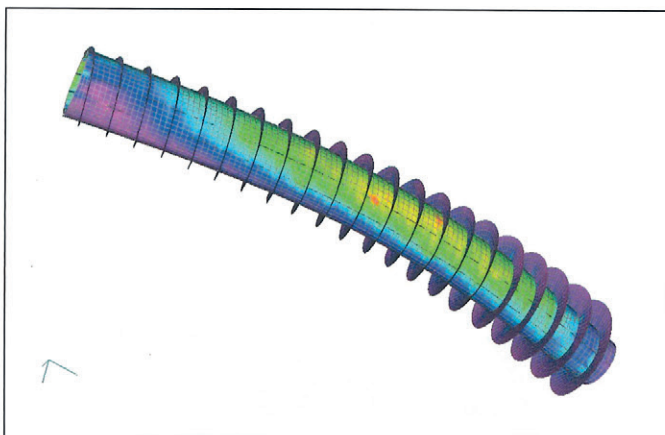


Figure 3. The presses pre-assembly in our workshop



Figure 4. Example of a FEM calculation on a press spindle



the storage in our stock of all the spare parts for the gearboxes, the pre-assembling and testing inside our workshop all the machines, besides the training of our customers on that occasion.

Spindles: Babbini carried out a thorough study (in cooperation with scientific institutes, welding institutes and sugar factories) to elicit problems associated with increasing workload. As a result Babbini has completely redesigned the press screws starting from the Check of the Strength of their supporting structure (FEM).

The company has analysed the entire manufacturing cycle and a substantial part of it has been modified on the basis of new manufacturing technologies, new materials, criticality of welding (both internal structural welding and external coating welding), and introduction in the cycle of new manufacturing phases to minimize the welding residual tensions, as well as to new controls, with the aim of making the press spindles, in particular the self-draining ones, stronger and more reliable, while keeping the same overall dimensions.

Press: The whole press in general has been strengthened.

B. Bigger presses maintenance

Even if we are aware of the need of keeping costs low, maintenance is a fundamental means of preventing damage which cannot otherwise be easily foreseeable.

- Press and gearbox ordinary maintenance during the campaign

Methodical lubrication of the rotating parts in general.

- Press and gearbox ordinary and extraordinary maintenance during the off season

Regular activation of the oil circulation pump + gearbox rotation, cleaning of the gearbox filters (delivery filter and suction filter),

possible replacement of the hygroscopic filters, check of the correct tightening of the screws (spindles supports and foundations).

- Preventive maintenance: periodical endoscopic controls on the gearboxes.

Complete internal inspection of the gearboxes (see fig. 5A and 5B), which are not so expensive if you consider the risk of troubles with the gearbox. This must be agreed upon depending on the gearbox age and exploitation, to allow to monitor to what extent gears are worn out (depending on their criticality degree and on the wearing statistics) and of the bearings (depending on their theoretical life and on their workload).

Considering the gearbox conditions, on its age and level of its use, it is possible to carry out a complete overhaul of the old gearboxes (partial or total replacement of the bearings, magnetoscopic check of the gears, complete overhaul of the lubrication system, etc.).

- Preventive maintenance: periodical opening of the presses

Depending on their level of use, it is advisable to alternatively open the presses (especially the old ones) every two/three years to check the conditions of the spindles, of the perforated plates, of the press level, etc.

C. Periodical checks and analyses

During the campaign it is necessary to continuously control the following operating parameters:

- Pressure and temperature of the gearbox oil (preferably continuously)

Figure 5a - 5b. Endoscopic controls inside the gearboxes



Figure 6. Press screws rotation control

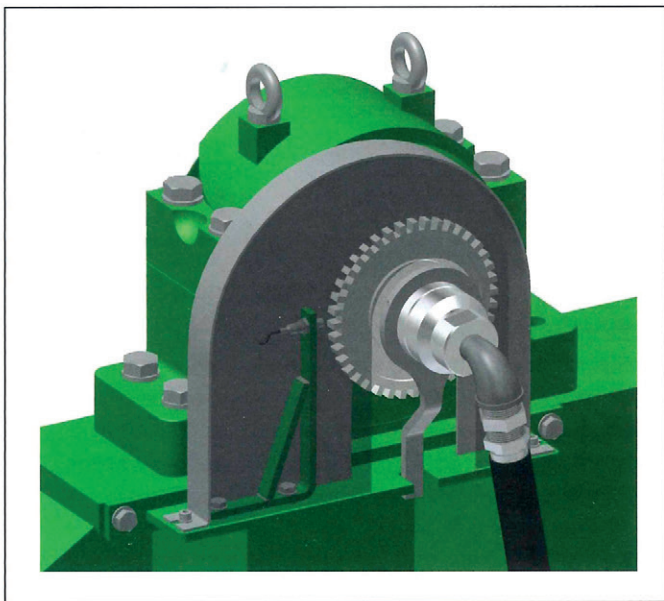


Figure 7. Off-line filtering gearcase



- Motor absorption
- Continuous monitoring of the press absorption, arrangement of safety levels and activation of protective actions depending on the absorption level.
- Absorption is the main source for the knowledge of stress on presses and therefore of the possibility of breakdowns.
- Spindles and cage flushing systems: periodical control of their correct operation
- Gearbox lubricant: periodical analysis and check of the contamination with water and iron particles, which must be carried out more frequently on old presses, already showing the first wear signs.
- Oil replacement/filtration in case of presence of water or iron particles.
- Vibrations (periodical detection)

D. Use of controlling and monitoring instruments

Nowadays it is possible to have at one's disposal the following controlling and monitoring instruments, which can easily be installed both on new and second hand presses:

- Spindles rotation: control system (Figure 6)
- Pulp outlet clogging: Control system
- Oil cleaning (gearbox): off-line filtration gearcase (Figure 7)
- Oil level (gearbox): electrical level indicator
- Oil flow (gearbox): electrical flow indicators
- Oil pressure and temperature (gearbox): electrical indicators
- Oil heating (gearbox): oil heater
- Oil cooling (gearbox): heat exchanger
- Moisture (gearbox): dehumidifying system
- Vibrations (gearbox): detection system (Figure 8: accelerometer)

E. Spare parts

F. Managing of the presses, of the station and of the process

For a complete protection of the presses it is highly advisable to keep under control the following aspects, tightly connected to the presses operation, which can cause anomalous mechanical stress on certain components:

Presses management

- Press speed of rotation: avoid continuous variations in speed and/or high speed.
- Presses feeding: try to keep the feeding hopper as much full as possible
- Presses stops and restart-ups: when possible, avoid a restart-up with full load.
- Press station management: Rational use depending on its characteristics and age.

Station

Arrangement of the Enabling Signals for the

Figure 8. Vibration system accelerometers

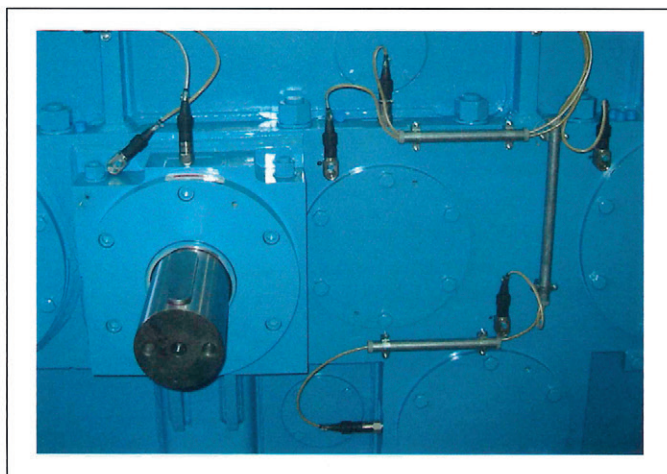


Figure 9. Deposit of sand on the filtering cage

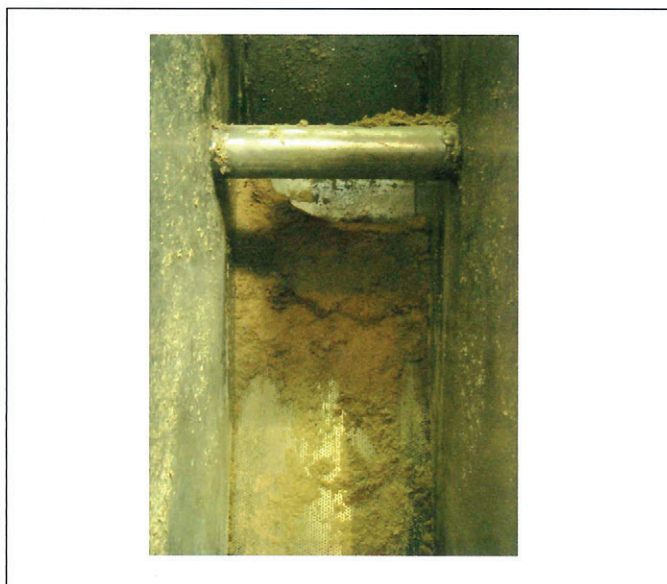


Figure 10. Cage screen plates deformed by holes clogging



presses start-up and stop and the activation of the Alarms depending on:

- Signals from the control devices (press, gearbox, motor)
- Operation or stop conditions of the machines connected to the press (conveyor after presses, drive motor, etc.)

Beet processing

A non-correct beet processing (with non-ideal parameters or with parameters very variable in time) can cause significant mechanical stress on some components of the press.

The main problems can derive from:

- Sudden changes in the beets processing parameters
- Highly variable and/or too low pH value (uncontrolled sulphuric acid dosage)
- Excessively variable lactic acid values (a controlled Infection in Diffusion with a minimum dosage of sulphuric acid is preferable)
- Excessive hardness values (Gypsum Dosage), especially with a high marc content in beets.
- Low temperatures, especially during start-ups, or excessive temperature during operation.
- Excessive fine pulp presence, which should be eliminated by the cycle, since they clog the holes of the perforated plates, thus negatively affecting the presses performances.
- Non-accurate beet washing (excessive presence of sand clogging the holes of the perforated plates, especially on machines equipped with special enbloc perforated plates) (Figure 9).

In Figure 10 cage screen plates deformed because of holes clogging.

Many of the aspects pointed out in point F can considerably affect also the pressing efficiency.

Conclusions

Taking into consideration the physiological limits of mechanical pressing, it is necessary to provide suitable working conditions for pulp presses, with the aim of improving performance.

Babbini is investing in research and places at their customers disposal a maintenance, assistance and monitoring services for the presses the company supplies.

However, it is necessary to be aware of the fact that safety and good performance of a press not only depends on its designing and manufacturing, but also on how it is both managed and maintained.

The end-users must be aware of the fact that, inside a sugar factory, the press is one of the machines mainly subject to stress. It is as necessary to pay attention to presses as it is with any of the process house equipment in sugar factory.

Therefore, the customer himself, managing the entire cycle at the end of which the press is installed, can avoid heavy machine stops by taking simple precautions and pre-emptive measures (in particular on old, very stressed presses which are installed in the open air), which are not commonly taken.