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The role and the influence of fine pulp in sugar beet processing

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The role and the influence of fine pulp in sugar beet processing

Bedeutung und Einfluss von Zuckerrübenfeinpülpe bei der Rübenverarbeitung

Recycling of fine pulp, i.e. small pulp fragments, formed during pressing of exhausted cossettes impairs the correct operation and the performance of the pulp press station. In general, the recycling negatively influences the economics of a sugar factory causing increasingly higher costs in the course of the campaign, for example, due to lower perfomance of the pulp presses and extractors or by increasing the infection level
In order to optimise the pulp pressing operation it is recommended first to separate fine pulp from the press water and then to press fine pulp by means of dedicated presses, thus increasing the overall value of pressed pulp.

Key words: sugar beet processing, fine pulp, pulp presses

Die Rücknahme von Zuckerrübenfeinpülpe, d.h. Zuckerrübenschnitzelkleinstteilen, die während des Pressens der extrahierten Schnitzel entstehen, beeinträchtigt die Funktionsfähigkeit und die Leistung der Schnitzelpressen. Im Allgemeinen verschlechtert die Rücknahme die Wirtschaftlichkeit der Zuckerfabrik durch die Erhöhung der bakteriellen Belastung und führt zu höheren Kosten, z.B. aufgrund der höheren Beanspruchung der Schnitzelpressen oder der Schnitzeltrocknung.
Um die Arbeitsweise der Schnitzelpressen zu optimieren, wird empfohlen, die Zuckerrübenfeinpülpe vom Presswasser abzutrennen und anschließend mit Hilfe von speziellen Pressen abzupressen, wodurch sich der Gesamtwert der Pressschnitzel erhöht.

Schlagwörter: Zuckerrübenverarbeitung, Zuckerrübenfeinpülpe, Schnitzelpressen

1 What is fine pulp and how it is generated

Fine pulp consists of small beet pulp fragments which gather on the perforated plates of pulp presses (Fig. 1) and leave the press in part together with the pressed pulp and in part together with the press water. According to *Buia* (2011) one should not talk of press water, but of a mixture of water and suspended and dissolved solids.
Many factors in sugar beet processing, which are difficult to quantify, have an influence on the amount of fine pulp formed during pulp pressing. In addition the rate of formation varies during the campaign. The main factors are:

- The beet quality, which varies depending on ripening level and the storage conditions, i.e. either freshly harvested or stored with varying degree of degradation or even frozen.
- The cossette quality, which depends on the type of beet slicer i.e. drum or disc type and on the knife status (wear conditions). It is characterized by the Silin number (length of cossettes) and mush content.
- The treatment of the cossettes in the extractor, mainly temperature and retention time.
- The dry substance content of pressed pulp: a higher pressure inside the press tends to break and tear the fibers of the cossettes to a greater extent, thus generating more fine particles.
- The fine pulp recycling: When fine pulp is recovered by filtration of the press water, and the separated fine pulp is added to the exhausted pulp entering the pulp presses the amount of fine pulp in the system of pulp presses and press water filters increases during the campaign.

Fig. 1: Fine pulp gathering on the perforated plates of pulp presses

As shown in Figure 2 the amount of fine pulp entering the pulp presses per unit time increases up to a time t_f when the amount of fine pulp leaving the pulp press together with pressed pulp is equal to the amount entering the press reducing the performance of the presses.

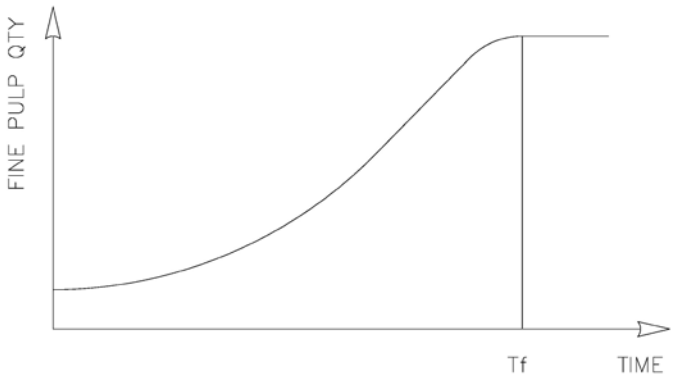

Fig. 2: Increase in fine pulp quantity in case of their recycling in presses

2 Influence of fine pulp on pressing performances

Recycling of fine pulp to the exhausted pulp before the pulp presses, which is very common in sugar factories, negatively affects the press performance both from the point of view of achievable dry substance content and of throughput. Pulp fragments, in fact, tend to clog the holes of the perforated plates and reduce the draining action of the perforated plates. Since the designed volumetric reduction of the pulp cannot be achieved, the forward movement of the pulp inside the press is more difficult..

This phenomenon mainly occurs in case of pulp presses equipped with:

- **Perforated spindles**. Fine pulp tends to clog the perforated plates of spindles and, sometimes, also the drainage channels reducing the advantages of perforated spindles. The dry substance content of pulp pressed with presses equipped with perforated spindles is approximately 1–2 percentage points higher than of pulp pressed with solid spindles.
- **Special enbloc plates in the filtering cage.**
- **The holes of special filtering cage enbloc plates** (type A, Fig. 3A) clog much easier than the holes of perforated plates of older design (type B, Fig. 3B), consisting instead of a thick supporting plate and a thin filtering plate.

Moreover in presses equipped with perforated spindles the holes of the perforated plates of the spindles clog more easily than the holes of the cage perforated plates. The reason is that

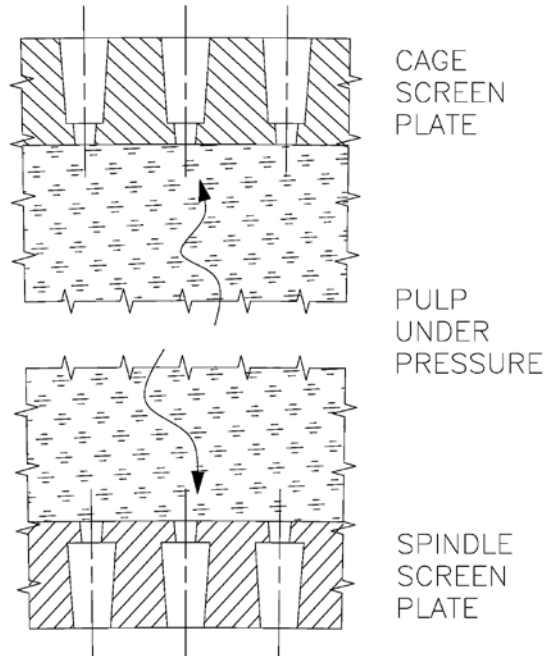

Fig. 4: Deformation of the holes special perforated plates (type A) of the spindle and of the cage after rolling

the holes suffer deformation when the plates are rolled in the manufacturing process. The rolling tends to close the holes in the plates of the spindles and to open the holes in the plates of the cage (Fig.4).

It must be said that the need to eliminate fine pulp was less important in the past, since the holes in the old thin filtering plates (type B) rarely clog. Press water drains regularly and continuously from these perforated plates. With enbloc perforated plates (type A, Fig. 4), instead, fine pulp certainly causes a reduction in the perforated surface. This is demonstrated by the typical water spurts that can be seen in presses with these plates The small holes clog and later are opened thanks to the effect of the internal pressure of the pulp press (Fig. 5).

However, presently the enbloc plates (type A) are generally preferred because of their higher reliability in case of foreign bodies inside the press.

Comparative tests have been run at a sugar factory using 2 Babbini PB22 presses, placed side by side, under the same operating conditions. They were equipped with different types

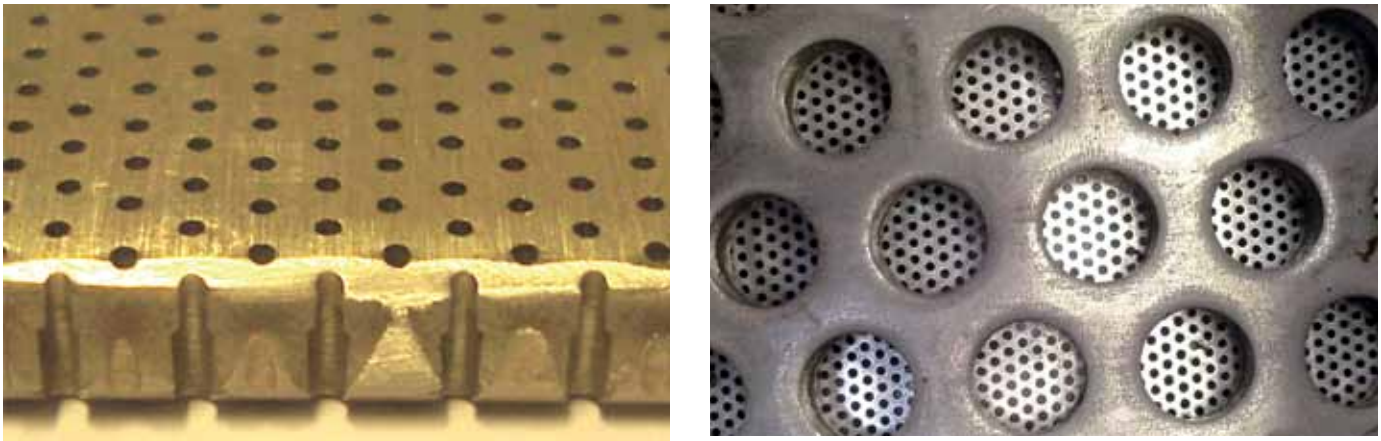

Fig. 3: Special enbloc perforated plates (A, left) *versus* standard perforated plates (B, right)

Fig. 5: Spurts in the enbloc perforated plates (type A) following the opening of the holes clogged by fine pulp

Table 1: Comparative performances recorded on 2 Babbini PB22 presses under the same operating conditions with different types of cage perforated plates

Pressed pulp DS %	
Standard plates (B)	Special enbloc plates (A)
28.2	26.3
28.4	26.3
27.3	25.8

of perforated plates for the cage, but with similar filtering surface area. These tests showed what was already known before, i.e. that presses equipped with standard plates (type B) produce pressed pulp with a dry substance content of at least 1 percentage point higher than presses with enbloc plates (Tab. 1). The most likely reason for the difference is that fine pulp clogs the enbloc plates and thus reduces the pressing efficiency.

Figure 6 shows the dry substance content of pressed pulp recorded on the same press with and without fine pulp recycling. The diagramm clearly shows the negative influence of fine pulp recycling on the dry substance content of pressed pulp. Since, as shown in Figure 2, the fine pulp content increases over time and so also the effect on the dry substance content of the pressed pulp increases over time and can exceed over 1 percentage point.

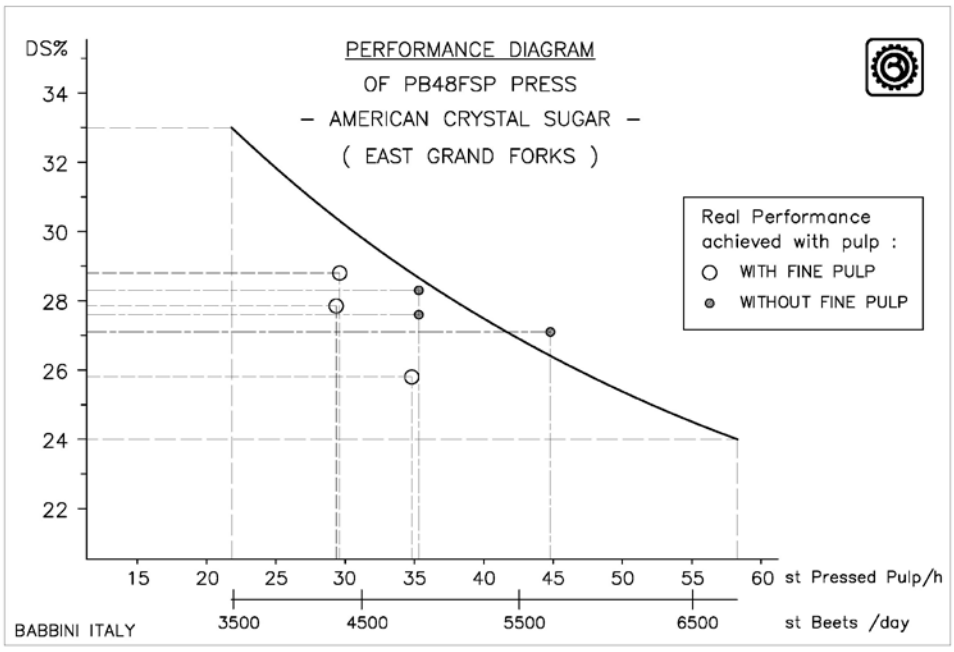

Fig. 6: Pressed pulp dry substance contents achieved with the same press fed with (O) and without (o) fine pulp recycling

3 Advantages from the elimination of fine pulp from the production cycle

The negative influence of fine pulp mainly affects the press station, however elimination from the press water and separate pressing of fine pulp could lead to the following FURTHER advantages (which are listed here below together with the ones that have already been previously described). They are in part difficult to quantify since they are not supported by experience or by experimental tests:

1 **Higher DS content of pressed pulp at constant throughput.** The same number of presses can deliver a higher absolute dry substance content for the same beet slicing rate, leading among other advantages to lower fuel consumption in the thermal drying and lower sugar losses.

2 **Increase in press throughput at constant DS content.** The number of presses needed to process the same amount of beet is reduced.

3 **The advantages of enbloc perforated plates (type A) are better exploited.** The use of these plates is preferred in the press cage due to the higher reliability, even if as in the case of fine pulp they drain less water than standard plates (type B).

4 **Presses equipped with perforated spindles are better exploited.** These presses certainly have better press performance compared with presses equipped with unperforated spindles. The performance difference can amount to 1–2 percentage points in the dry substance content..

Lower mechanical stress on pulp presses. Perforated plates clogged by beet sludge, fine pulp and tails result in an increase in internal pressure of the press and therefore to higher power absorptions and higher mechanical stress on the press elements (press spindles, perforated plates etc.).

Less water is needed for flushing of press spindles in presses equipped with perforated spindles. The risk of clogging of channels is reduced.

7 **Higher sugar recovery** from fine pulp press water.

8 **Higher raw juice purity** thanks to the higher press water purity.

9 **Lower fuel consumption in thermal drying**. Since pressed pulp with a higher dry substance content is produced, less fuel is needed in thermal drying. In addition fine pulp can easily be dried without negative influence on dryer performance or, even better, they tend to partly burn and thereby produce heat.

10 **Lower infection levels in extraction.** Lower fine pulp levels in the pulp presses reduce the deposits of fine pulp in stagnant areas of the pulp press (such as for instance the filtering cages and the press water tank), which are ideal places for colonies of thermophilic bacteria to generate and proliferate. Lower bacterial activity here reduces the number of bacteria in the press juice recycled to the extraction. This leads to advantages such as a lower use of biocides and anti-foaming aids.

11 **Better extraction performances**. Inside the extractor a higher fine pulp content due to recycling reduces the movement of water between the cossettes and interferes with the normal juice circulation. However, the worst consequence is the clogging of the sieves of the extractor (normally due to the presence of small particles mainly coming from beet slicing), which has negative effects mainly in tower extractors.

The press water filtration should prevent the recycling of fine pulp to the extractor. However, the press water filters are often overloaded with fine pulp and so they let a certain amount of fine pulp pass through. This amount of fine pulp passing through the press water filters increases during the course of the campaign.

In order not to risk higher sugar losses in extraction it is therefore necessary either to increase speed of the moving parts of the extractor or to increase the extraction temperature. This results in higher stress of the equipment and, in any way, in a lowering of the extraction efficiency.

Fig. 8: Fine pulp presses (P30BC + P40BC)

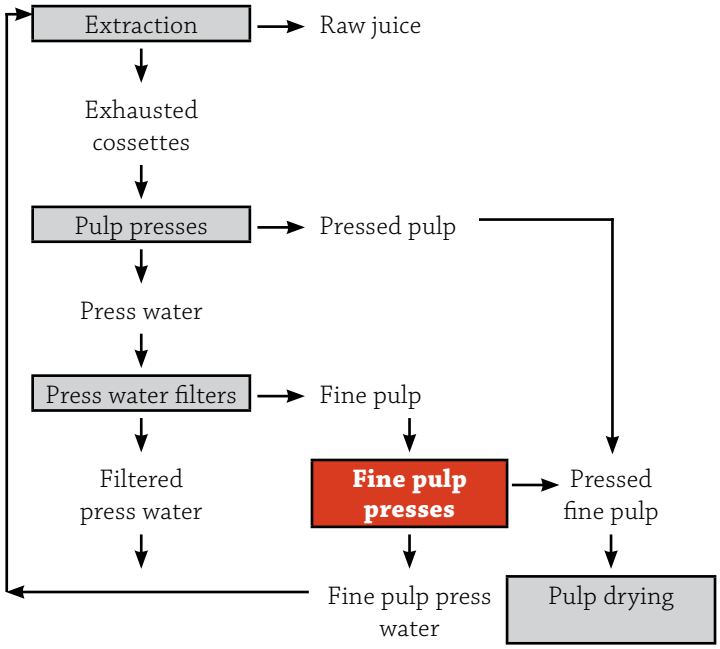

Fig. 7: Schematic scheme of mass flows after installation of a fine pulp press

4 Fine pulp press

The installation of a fine pulp press as shown in Figure 7 could solve these problems by elimination of the recycling of the fine pulp. The fine pulp would then not be returned to the pulp presses with its negative consequences for pulp pressing and extraction. The fine pulp press water can be added to the extraction together with the pulp press water. The pressed fine pulp has a dry substance content of up to or even higher than 30%. It can be mixed with the pressed pulp without lowering its dry substance content substantially and can in any case be dried easily.

Twin screw presses for fine pulp are of much smaller size than the ones used to process exhausted cossettes. Moreover, considering the properties (size etc.) of fine pulp, some elements of these presses are different from regular beet pulp presses. In particular, the press spindles are of special dimensions and designed on the basis of the necessary compression ratio and the perforation of the filtering plates is adjusted to drain water out of the small particles to be pressed.

5 Experience in fine pulp pressing

The use of small dedicated presses to process fine pulp after its separation from press water is not very common in the sugar industry up to now. However, the few known installations show the advantages of fine pulp pressing.

The sugar factory in Minerbio (CoProB,

Fig. 9: Fine pulp filters from press water

Italy, capacity approx. 14,500 t of beets/day) is a leader in this respect. Since 2002 it has been using a small Babbini P40BC press to press a part of the fine pulp produced. Recently a Babbini P30BC press was installed additionally in order to completely eliminate the fine pulp recycling.

The two small presses work in parallel (Fig. 8) and process all fine pulp coming from 4 press water filters (Fig. 9). The separated fine pulp has a dry substance content of 5–7% and is pressed to a final dry substance content of 29–32.5%. The pressed fine pulp is sent directly to the pulp dryer.

As a result of the new installation the dry substance content of the pressed pulp increased by more than 1 percentage point over the whole campaign thanks to the elimination of fine pulp recycling.

6 Conclusions

Sugar factories often recycle fine pulp to the pulp presses. The recycling more and more affects the economics of a factory negatively because it not only increasingly impairs the correct operation, management and performance of the pulp press station but subjects the pulp presses also to higher mechanical stress. Further additional direct and indirect costs can be attributed to fine pulp recycling.

Removing fine pulp from the feed of the pulp presses, after separating it from press water, is a first important step, which makes it possible to optimize the pulp pressing operation, even if the addition of (unpressed) fine pulp to pressed pulp would lead to a drastic reduction in the final dry substance content of the pressed pulp.

In order to optimize the sugar manufacturing process it is therefore highly suggested to separately press fine pulp by means of a small dedicated press. Its low investment cost and its many advantages widely justify its use in sugar factories.

Indeed, it is not only a matter of increasing the value of the pressed pulp, but its introduction positively affects the economics of a sugar factory in many aspects. Babbini is available to deeply discuss and analyse the specific needs of each customer.

References

1 *Buia, F.* (2011): L'Industria Saccarifera Italiana 104 (No 4), 60

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