**KRAFT, BCTMP and TMP dewatering in a screw press: A statistical modeling.**

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**Highlights**

* The pulp behavior is very similar regardless the type of the pulp.
* The behavior is predicted statistically with a good approximation.
* The screw rotational speed is the most significant factor.

**1. Introduction**

Screw presses are used for solids/liquids mechanical separation. As dewatering is one of the most important unit operations in the pulp and paper industry, this study was conducted to establish a statistical relationship between the operational parameters and the main outputs of the screw press.

The objective of this study was to analyze statistically the main outputs and try to find a predictive model of the screw press.

**2. Methods**

For this study, we used JMP from SAS for experimental design and statistical analysis.

The screw press used in this study is a Thune SP23 screw press from Voith. Four pressure sensors and fourteen filtrate baskets were installed along the screw press to track the pressure variation and filtrate characteristics.

**3. Results and discussion**

- At first, the designs were including the quadratic effects. After analysing all the data on JMP, the design can be reduced in most cases to having just the interactions parameters.

- For Kraft pulp, the R squares varied from 0.89 to 0.97 in the interactions model. The BCTMP model gives R squares from 0.85 to 0.98, and for TMP the R squares varies from 0.72 to 0.97.

- JMP allows us to see the effect of the parameters using a profiler for each pulp. In our case, we have chosen to observe the effect on the pulp outlet consistency and inlet flow; the filtrate consistency and flow rate; the screw press production; the pressure in the basket 4 near to the discharge end and finally the screw torque.

- The outlet consistency is mainly affected by the screw rotational speed. For the three-pulp studied, the outlet consistency decreases with increasing the rotational speed. Increase the rotational speed implies a reduction in the residence time, thus not enough time for the pulp to dewater, especially in the first section of the press. Comparing the three pulps, the rotational speed effect is more pronounced for BCTMP and TMP compared to KRAFT. This can be explained by the fact of the fibres size, the KRAFT fibres are almost twice longer than those of TMP and BCTMP, thus, the filtration process is faster and even when increasing the rotational speed, the filtration stage is less affected. The other difference is for BCTMP, the outlet consistency increases more when increasing the freeness, by knowing that both KRAFT and TMP fibres are softwood and BCTMP fibres are hardwood, we can expect this difference is due to the fibres inner properties. The fiber length, the quantity of fines and the flexibility of the long fibers are to be considered.

- The filtrate flow rate increases with increasing the screw press and the feed pressure. This flow increase was observed to happen at the same rate for the three pulps and it can be explain by the fact, when increasing the rotational speed and the pressure, the pulp moves faster, giving a dilute suspension behind the screw flights, allowing the pulp to drain faster in the first section of the press. The drainage is more important when operating with higher freeness, so in this case the inlet flow increases when increasing the freeness, this was observed for KRAFT and TMP, for BCTMP we do not notice any variation. As mentioned before, KRAFT and TMP are softwood, and TMP is a hardwood, this can explain the difference observed when varying the freeness. On the other hand, when increasing the consistency, the pulp is more compact, and the fibres form a network that slows the drainage, thus giving a lower filtrate flow rate.

- The filtrate consistency increases with increasing the rotational speed, since when increasing the rotational speed, the perforated barrel is rapidly cleared off by the screw moving flights, allowing the fines and some fibres to slip from the screw press. The filtrate consistency is influenced by the feed consistency as well, increasing the feed consistency will give a more compact suspension rapidly, thus blocking the fines and fibres from sliding out of the press. The KRAFT and TMP response to the parameters variation is similar, whereas, the BCTMP is more sensible to the parameters variations, the slop is more important.

- It is obvious when increasing the rotational speed, we increase the inlet flow. On the other hand, when feeding the screw press with a more concentrated suspension, the inlet flow is lower for a same production rate, increasing the consistency will increase the shears in the screw press, thus implying a lower screw linear advance and lower inlet flow rate. These observations are the same for the three pulps studied, the only exception is the freeness, where it has no effect for the BCTMP.

- The screw press production increases with increasing the rotational speed, the pressure, the freeness and the feed consistency. The behavior is identic for the three pulps studied.

- The pressure does not change much in the screw press, only near to the discharge end where we have a noticeable increase. The rotational speed is the most significant factor, increasing the rotational speed implies a less important pressure near to the discharge end. Increasing the rotational speed pushes the pulp faster to the discharge end, thus the pulp drains by filtration and we do not have enough time for pressure build up. The three pulps react the same way to each variation.

- The screw press torque decreases when operating with high rotational speed because the shear is lower. The degree of variation is the same for the all the pulps studied.

**4. Conclusions**

- The rotational speed is the main factor that has the biggest influence in the screw press.

- The pulp behavior is very similar in the screw press for the three studied pulps. There is only a slight difference when changing the pulp type (softwood or hardwood) or fines or short fibers content.

- JMP analysis shows that the screw press outlets can be predicted with a very good approximation for each pulp.