

Fig. 2: The Ogumazer in a Japanese packaging mill. Feeding from the top, dewatering and compression in the center, extrusion and cutting on the left. © Wolf Heilmann

A novel approach to transform rejects in valuable fuel

Solving two big papermaking challenges using the Ogumazer

Wolf Heilmann

Rejects are a very costly problem to paper mills, as quality of recycled fibers are deteriorating. Good recycled fibers are often too expensive, but principally just scarce. Two expensive challenges are linked to this challenge.

First, the rejects from this fiber supply make up 5% to 20% of the total production of the mill, depending on the paper grade manufactured and the quality of the recycled fibers. Second, the cost for treating those rejects reach in Central Europe 80 to 160 €/t.

Deinking and fiber sludges cost roughly one third to half of this amount. In total, the rejects may cost up to 40 €/t of paper.

The reject extruder Ogumazer is one solution for reducing this cost. In a single step, it extrudes wet reject with 20% to 50% dry content to dry pellets with at least 70% dry content at the exit. At the same time the rejects are subjected to temperatures above 70°C, which subsequently bring the dry content of 70% at exit up to 85% and above through evaporation within 24 h.

This brings the caloric value of the pellets to levels comparable to lignite, coal and even biodiesel. Thus, those pellets can be used as high caloric fuel and generate energy for the paper mills – reducing their requirement for fossil fuels. Transforming cost into profit.

Rejects- a huge and costly problem

In 2021 alone in Germany 3 million tons of rejects are found in paper industry. Which had a production of roughly 20

million tons of paper – thus the rejects make up 15% of the total produced tonnage of paper and board. In Europe, roughly 20 million tons of rejects were generated in 2021 (Fig. 1).



Fig. 1: Different fine and coarse rejects as well as sludges from different European paper mills.
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80% of those rejects are going into thermal recycling. With an average moisture of 50% there's a big loss in caloric value. This requires the use of fossil fuel for supporting fire.

The Institute for Anthropogenic Material Cycles of the RWTH Rheinisch Westfälische Technische Hochschule Aachen together with paper mills and industrial partners like PROPAKMA had started a research project SPaRe to evaluate the waste cycles in the paper industry and to find out how creating valuable side streams as well as material recycling of fibers and plastics.

The project helps:

- first to define recycling paths for the different rejects found in the paper industry.
- Second it develops rating measurement tools to characterize the different rejects found in the paper industry.
- These characterization methods help thirdly to increase the reuse in the circular economy. As a first step the reuse of fibers found in the rejects should be eased.
- Most important will be the fourth step, the evaluation and rating economic modelling of the different recycling paths will be provided. Only when it is known how different paths can be made economically viable the industry can take the required decision to implement those recycling and reuse paths in their business model.
- As fifth step, those processes will be optimized, to generate the least cost and burden for the paper industry.

Main topics for the adaptation will be the optimization of the pulping process. This needs to be improved to have a significant better separation of the fibers, which can be used in the paper mill. Usable plastics may be sorted out, to recycle them in plastic production.

The remaining rejects must be optimized in their caloric value. Ideally the remaining waste will be turned in a valuable side stream in the paper mills.

Here, the Ogumazer is the ideal tool as it increases at very low electric consumption the caloric value to such levels that no more supporting fire will be needed.

Details of SPaRe project will be published later by ANTS Institute for Anthropogenic Material Cycles.

Ogumazer – the reject pelletizer

The original use for the Ogumazer was the pressing of mixed, non-recyclable plastic and transform them in high energetic pellets which were used either for energy generation in furnaces or as additives in construction or road base.

It consists of a double screw press with extruding nozzles, which compress the rejects and heat them through internal friction as well as friction between the rejects and the screws as well as the walls (Fig. 2).

For use for paper industry rejects with low dry content, a dewatering zone was added at the first phase of the compression zone. This allows extracting big parts of the water.

The Ogumazer is fed though an overhead feeding system. In paper industry the rejects have typically 20% to 50% solids content. After dewatering and compression, the dry solids exceed 70%, and the output temperature ranges between 70°C and 95°C. The compression level can be adjusted by increasing or decreasing the length of the compression chamber. The higher the compression, the more dry solids and temperature will increase, due to the increased time of internal friction.

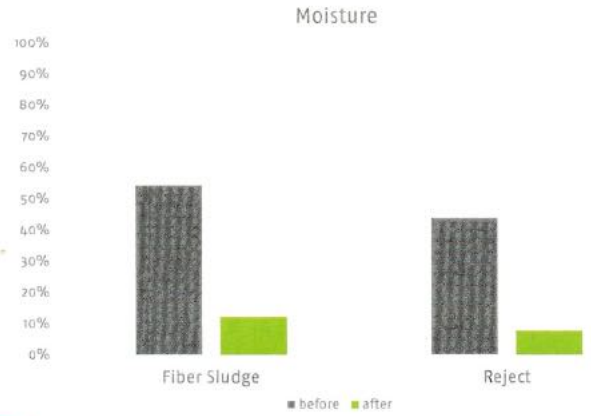


Fig. 3: Average reduction of moisture for fiber sludges and rejects before and after the Ogumazer © Heilmann

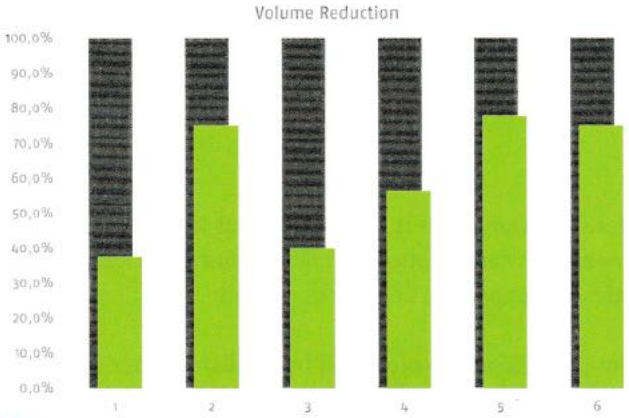


Fig. 4: Average reduction of volume for fiber sludges and rejects before and after the Ogumazer © Heilmann

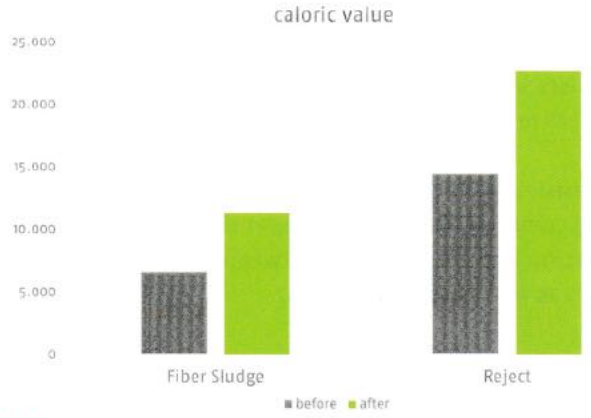


Fig. 6: Increase in caloric value for fiber sludge and plastic rejects © Heilmann

The latent heat in the pellets pushes evaporation after pelletisation – the maximum dry content is reached after 24 h when the pellets are subjected to slight ventilation. The ventilation breaks the laminar layer, which normally traps the vapor in the pellets. After 24 h, dry solids of up to 97% have been observed.

Is the Ogumazer the solution to the reject challenges?

Those significant levels of dry solids are achieved through the mentioned compression, with dewatering at the beginning. Internal friction evaporates water; this will be forced furthermore when expanding at the extruding nozzles. Subsequently the latent heat brings the solids to such levels, that caloric values like biodiesel can be achieved.

This significant moisture reduction is achieved on fiber sludges as well as fine and coarse rejects. In average, the moisture of fiber sludges or deink sludges can be brought from 55% down to 12%. On fine and coarse rejects, the moisture is brought down in average from 45% to 8%, which is the final moisture after 24 hours (Fig. 3).

This moisture reduction significantly lowers the transportation costs as well as treatment costs. As in average the moisture of such rejects was 50%, the transportation volume as well as the transportation weight can be reduced by 35% to 70%. This gives a dramatic reduction of transportation cost, paying back the Ogumazer very fast (Fig. 4).

For deinking sludges, the volume reduction is less, as the pigment contained can't be compressed. So in newsprint mills, where lot of fillers are brought into the furnish, and then eliminated, the volume reduction will be less, as a lot of fillers will be either in the deinking sludge or in the fiber sludge. On coarse and fine rejects, however, the volume reduction as well as the weight reduction will be substantial (Fig. 5).

Fiber sludges will deliver typically pellets with average caloric values of 12,000 J/g, like lignite, almost doubling from the original value. Thus, they can be burnt without the need of supporting fire. Fine and coarse rejects typically increase the average caloric value from 14,000 to 23,000 J/g and sometimes exceeding them up to 28,000 J/g (see fig. 4).

So, besides the enormous cost saving based on the reduction of volume and weight, the significant increase in caloric value allows to substitute fossil fuels in the furnace (Fig. 6).

The Ogumazer is extremely efficient. No energy is used for heating the rejects. Only the friction between the reject particles as well as between rejects and screw creates the heat up to 95°C. Typically, the Ogumazer requires in average some 60 kW per ton of rejects, resp. some 30 kW per ton of sludges to increase the solids contents to above mentioned levels and reduce the moisture level to those reference values. The highest value observed was 95 kW per ton of coarse reject, the lowest 22 kW per ton of fiber sludge.

Depending on the consistence of the rejects and sludges, the increase in caloric value reaches in average 30 times the electric input respectively 50 times. Sludges deliver reduced resistance, as their flow properties when passing the Ogumazer are better than those of the rejects (Fig. 7).



Fig. 5: Pellets from coarse and fine rejects as well as sludges © RWTH Aachen

Another extremely important factor is the level of temperatures reached – not just for reducing the moisture content: it kills microbiological activities as the conditions are similar to a pasteurization. This eliminates another huge problem of rejects, the odor. Only some heat-resistant fungi survive the treatment. But their subsequent activity is strongly limited, as the substrate, i.e. the pellets, has too low levels of moisture allowing microbiological activities after pelletization.

The Ogumazer - the solution for rejects and energy!

The Ogumazer increases strongly the solids content and reduces significantly the moisture content of the rejects. The pellets can be used for incineration without requiring supporting fire. The transportation cost to the incineration plant is reduced between one third and two thirds. The pellets can now be sold as valuable fuel. So instead of paying 80 € to 160 € per ton of reject or sludges the paper mill will be paid for a valuable fuel. This transforms cost into profit. In a particular case, these pellets will make up roughly 10% of the fossil fuel consumption.

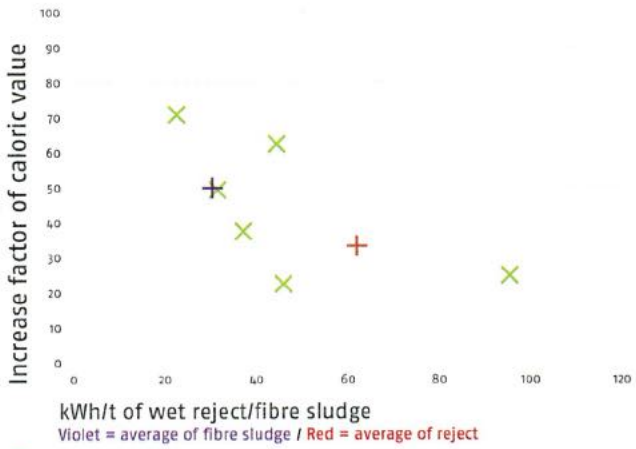


Fig. 7: Average increase factor of caloric value relative to the required electric energy © Heilmann

As the cost for pelletizing is very low, the profits coming from this process allows improving the sorting before the pelletizing. It pays back improved fiber recovery, reducing thus the cost of raw material. Additionally, some plastics may be sorted out, those which can be recycled easily and where the quantity is sufficiently big.

Additionally, the heating of the rejects during pelletizing is similar to a pasteurization – eliminating the typical odor of rejects. For mills in a city or village this is highly important. As the Ogumazer requires much less electric energy than the thermal energy it creates, this allows paying the sorting process ahead of the pelletizing, thus creating the fringe benefit bringing fibers back into the process without additional cost. The pay-back period is typically as low as 3 to 18 months, depending on if additional fiber recovery and plastic sorting will be included in the project.

Thus, three huge problems of a paper mill are resolved with the Ogumazer.

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