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# Producing solid matter from the potato peeling process

*The processing of potatoes to semi and complete convenience products begins in the raw condition with mechanical peeling. According to [1] and own-research this produces up to 50% peel waste. Utilisation of this material with its main ingredient starch was the main aim of a research project. Requirements achieved so that the waste could be used in the paper industry were homogenising and dewatering. The technical and procedural solutions required are presented here.*

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## Keywords

Reworking of skrap, potato-starch, fragmentation, dewatering technique

Currently, it is hard to tell whether any changes in mechanical peeling might occur leading to great reductions in the resultant waste. This waste is tackled in different ways within the potato processing industry. Mostly it is sold at cost for inclusion in feed whereby the water thus produced contains much starch, leading through oxidation to smell problems during intermediate storage in collection ponds. Also where used in biogas systems, intensive wastewater processing associated with high costs is necessary.

Thus the targets to be aimed for in this project were:

- Utilisation of the starch in the peel waste
- Production of cheap starch for biologically degradable materials for the paper and corrugated cardboard industry and as binding agent for fibres of all types
- Reduction of oxidative burden in wash, rinsing and waste water
- Improving economic viability of potato product manufacture
- Detaching the waste flow from processing through subsequent maceration, homogenising and dewatering
- Separation of starch from the fluid phase according to the requirements of the further-processor
- Possible usage of the waste in feed
- Investigation of the role of potato substrate from peel waste in the paper industry

### Peel waste

Peel waste is suspended in water during the peeling process consists of potato skin, tissue particles and tuber pieces as well as free starch with the majority of the dry matter substance being starch.

The component „sludge clarifier" is added as part of the treatment. Prominent aspects are the pH (clearly in the acid range), the high starch presence and the notable proportion of protein (*table 1*). The wastewater

*Table 1: Subject matter and characteristic values of different suspensions [2]*

| Description | Dimension | Skimmer basin | Baffle plate thickener |
|---|---|---|---|
| PH - | 4,3 | 3,87 | |
| Dry matter | % | 1,42 | 9,57 |
| Starch | g/l | 10,5 | 85,4 |
| COD | mg/l | 10650 | 21975 |
| Protein | mg/l | 140,2 | 212,8 |
| Sulphite | mg/l | 0,62 | 0,83 |
| Redox | mV | 158 | 154 |
| Conductivity | mS/cm | 2,36 | 2,63 |
| Glucose | g/l | 1,42 | 1,27 |
| Ash | % | 0,52 | 0,95 |

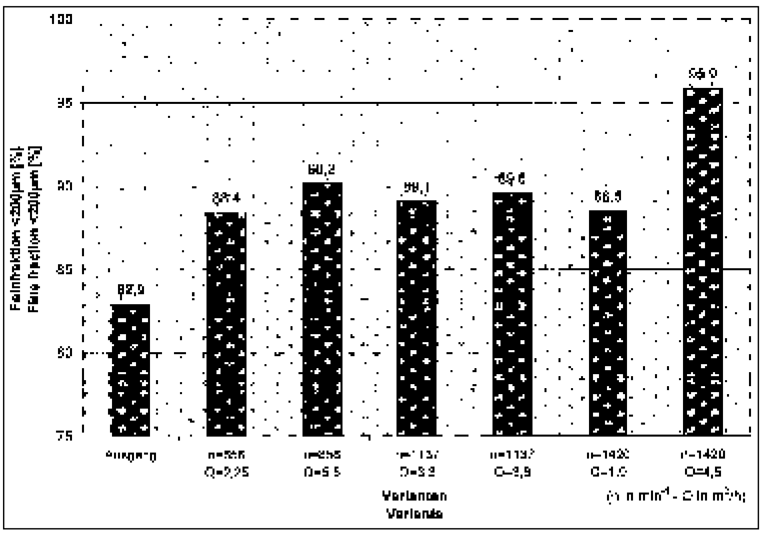

*Fig. 1: Percentage of fine fraction < 200 µm*

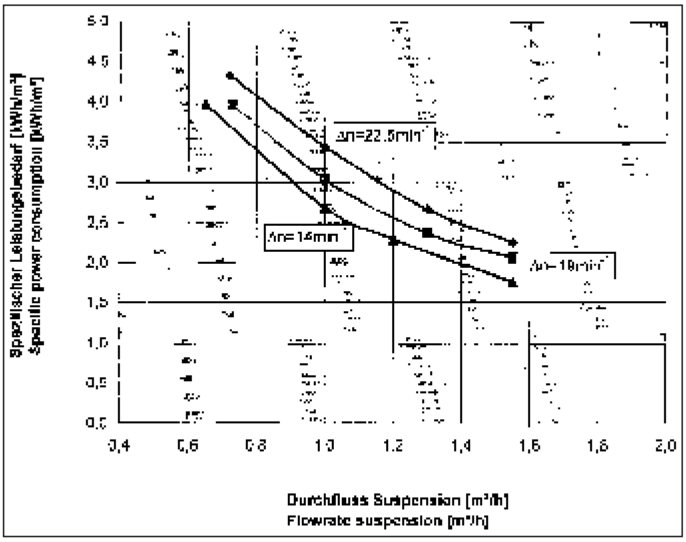


*Fig. 2: Specific power requirements as a function of the flow rate*

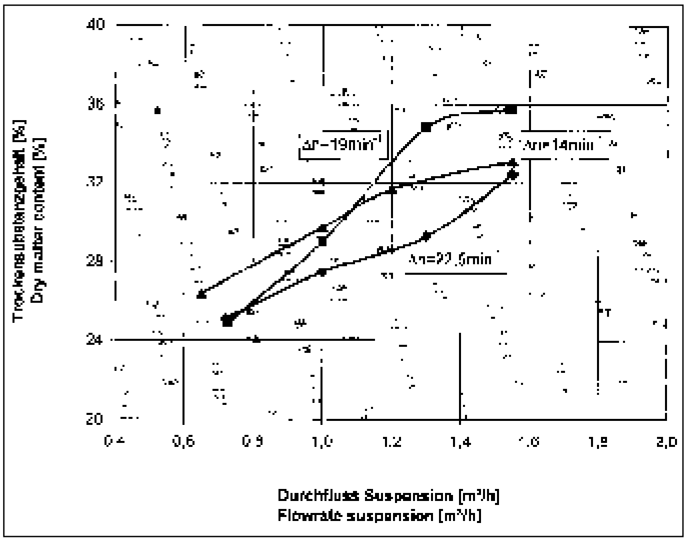


*Fig. 3: Dry matter content as function of the flow rate*

from production runs into skimmer basins. The high COD (Chemical Oxygen Demand) shows very clearly that a purely biological water treatment within acceptable time limits would not be successful. The current solution is therefore the spreading of this product as manure on fields.

The values presented in table 1 are based on averages from four individual measurements during the processing period.

### Laboratory particle reduction trials

In mechanical peeling and in automatic and manual grading the rejected potatoes or pieces of tubers end in the waste flow. As homogenous suspension with maximum proportion of free native starch is required for processing, macerating and homogenising is necessary.

Tested in the laboratory trials was a chopper system featuring the principle of milling wheel with rasp floor. This was evaluated regarding the amount of < 200 µm particles achievable. Such a standard came from the requirements of the paper industry where the starch fraction must be < 200 µm.

As seen in *figure 1*, the rasp system can give a further reduction in particle size. The proportion of fine fraction < 200 µm was around 90%, and 95% in an exceptional case. Throughflow and rpm had very little influence in the investigated range.

### Solid liquid separation

Main aim of the solid liquid separation is the separation of the starch as fully as possible from the processing water in the plant. From experience with the direct potato substrate production in the field [3] the auger centrifuge (decanter) was to be investigated under laboratory conditions. It was shown that, in association with throughflow and difference figure Δn, specific power requirement and dry matter content of the solid material can be influenced (*figures 2 and 3*). Should an extensive dewatering be planned, then work must be conducted with high throughflow below auger centrifuge power limit with an as low as possible difference figure Δn.

### Procedural solution

The concept of a procedural classification regarding the solid material produced from peel wastewater is mainly influenced by the market. In that it is not certain that the total solids (starch) can also be sold as raw material, the feeding option is retained with the existing sector „feed“ (*fig. 4*).

The peel waste from roller peelers 1 and 2 is run over a slat sieve and macerator into collection container. After homogenising and de-sludging with the clarifier, the first dewatering takes place. The solid material can already be applied for some purposes at this stage (e.g. production of packaging paper). A further dewatering is possible via auger centrifuge. The solids are then available for utilisation as before but also for conservation through the addition of stabilisation material or for drying.

A plant projection processed by cooperation partner Mühlenmontagen, Dresden fea-

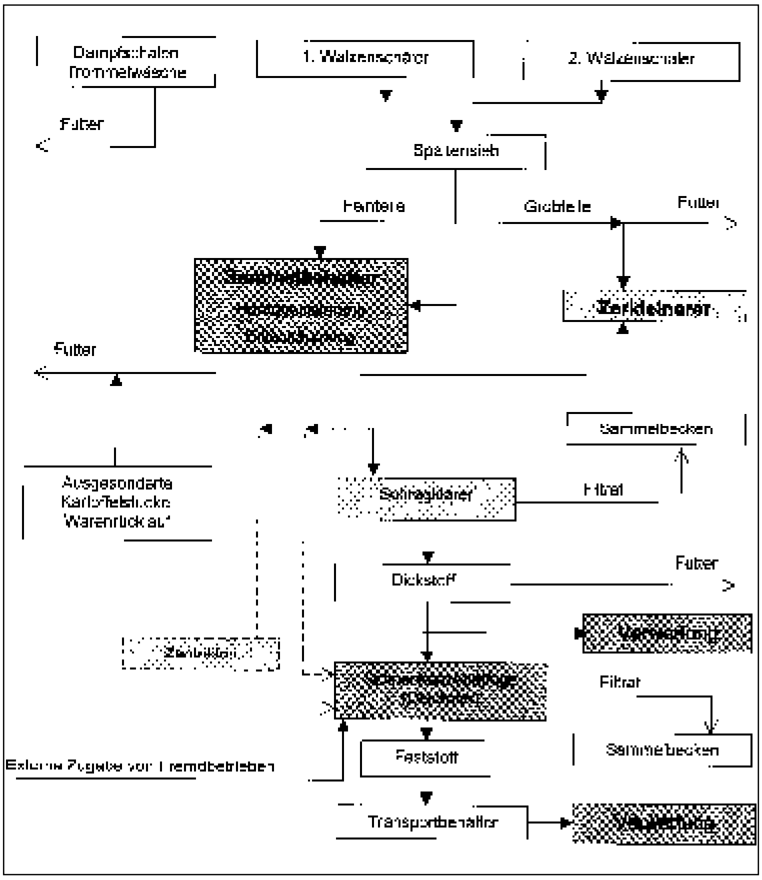


*Fig. 4: Process of extracting the solid matter*

tured the clear configuration of the expanded process considered the space possibility and the costs.

### Utilisation

With the Heidenau paper technology foundation as scientific cooperation partner, requirements and application areas for peeling waste in the paper industry were investigated. Also conducted was a wide range of laboratory investigations and technical trials, as well as results and experiences from tests in a paper factory [4]. During the practical applications two variants were investigated:

- Modification of the native starch through partial dewatering in the potato processing plant and subsequent macerating and heating to paste consistency with a jet cooker
- Partial dewatering of the peel waste and heating to 75 °C in the potato processing plant (unmodified potato starch)

It has been indicated that peel waste is suitable for packaging paper manufacture after modification and leads to improved strength of cardboard characteristics and a reduction in wastewater pollution. Following initial macerating, homogenising and partial dewatering the peel was run through a jet cooker where the starch water suspension was steam-heated to a temperature when the starch corns begin to expand (paste-forming temperature). Through the paste making, sedimentation in the starch during transport and storage is avoided, oxidation is slowed-down and direct dosing in the papermaking process is possible.

Selected dosing techniques, waste water pollution and board physical characteristics were tested in a wrapping paper plant using unmodified potato starch for fibreboard. Improvements in production characteristics achieved included increasing bursting and breaking resistance $F_{max}$ (*fig. 5*) of wrapping paper. Further, the application led to a reduction in wastewater pollution.

It can be concluded that even unmodified potato peel waste, where finely macerated and homogenised, can be used in the production of cardboard with reduced area mass but with retained thickness.

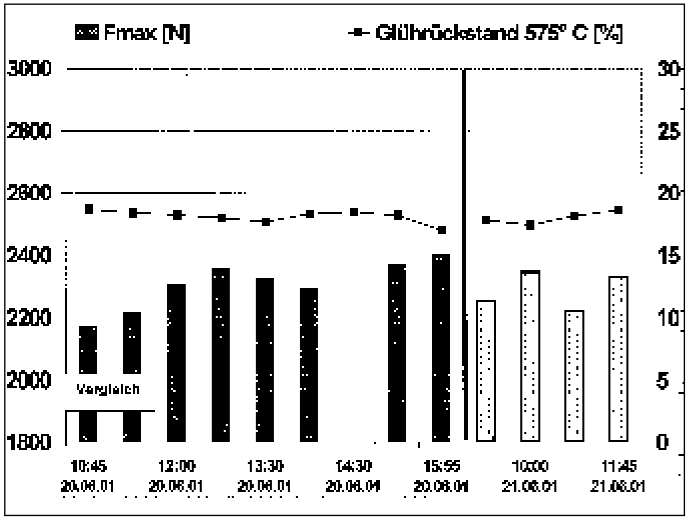


*Fig. 5: Influencing resistence to breakage of paperboards in a operating test through use of potato products [4]*

### Summary

Potato processing and especially peeling was analysed, based on the example of GROKAR Großhain. With limited technical input the waste flow could be directed into a collection pond. The macerating and homogenising of the peeling waste is indispensable because of the processing requirements in the paper factory. Clarifiers and auger centrifuges are suitable for increasing dry matter content. A procedural-technical solution for the preparation of the peel waste was evolved and tested during the application of peel waste in the paper factory. The results of these investigations showed that the peel waste was usable in the packaging paper production, that an improvement is achievable in the strength of the cardboard and that wastewater pollution could be reduced.

These results represent a first step towards industrial use of potato peeling waste in the paper industry.

It opens up new research areas for further modifying of potato peel waste, e.g. for fine paper production within the paper industry, for long-term conserving with minimum-energy drying and for the production of use-oriented, user-friendly materials and binding agents which are cost-efficient and biologically degradable.

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