New, innovative retentate treatment process

| Activated Carbon | Filtration | Microrganisms | Pulp | Sediment |

Use of the dynamic filtration principle, also known as crossflow, has established itself in the production of fruit juice concentrates. This filtration system allows direct and effective clarification of raw, ideally pectin-free juices with a proportion of pulp, which appear absolutely clear to the human eye. Whilst clarified juice passes through the membranes, fresh cloudy juice is constantly fed into the cycle. This is known as the feed & bleed principle (Fig. 1).

The sediments fed in consequently get concentrated in the filtration system. This applies equally to activated carbon that may be used to stabilise the desired depth of colour in apple juice. Most filtration systems permanently capture the solids in the cycle and stop filtering after a certain critical value is reached. The remaining retentate corresponds to a natural juice with many times the proportion of pulp and fibre (usually fragments of starches and pectins in fruit juices). The retentate can be leached by the addition of water and further filtering to obtain the not inconsiderable proportion of valuable juice. This counts in particular for the yield of colour pigments in case of berry juices.

This process is known as diafiltration. Even in this way, a large part of the organic and anorganic solids (sediment particles and fibres, pectins, activated carbon, bentonite) remains. In these cases direct discharge to clarification systems is usually no longer possible, or at least uneconomic. Depending on the size of business and process control, a company producing concentrate can generate 1,000 to several tens of thousands of litres of retentate per day of production.

Analysis of existing methods

Retentate displays very slight sedimentation and moderate filterability. This also applies to highly permeable filtration media, so that not inconsiderable expenditure is required to mitigate the expense of discharge to a clarification system.

Filtration of the – potentially slightly diluted – retentate using a relatively coarse perlite on a rotary vacuum filter and return to the production plant is frequently encountered. Considering the expenditure (filtration aid, hours of work, water consumption), volumetric flow rates are inadequate and the loss of valuable extract via settlement on the filter cake is entirely relevant. Furthermore, the retentate cools perceptibly during collection and laborious filtration. This can lead to rapid proliferation of microorganisms. It is not unusual for the retentate juice obtained to be not only of lesser quality, due to inefficient processing, but also simply unsuitable for fruit juice concentrate production due to the lactic acid content.

Diafiltration represents a simple way of adding value, including from retentate. This is offset, however, by the use of large volumes of process water. A medium-sized

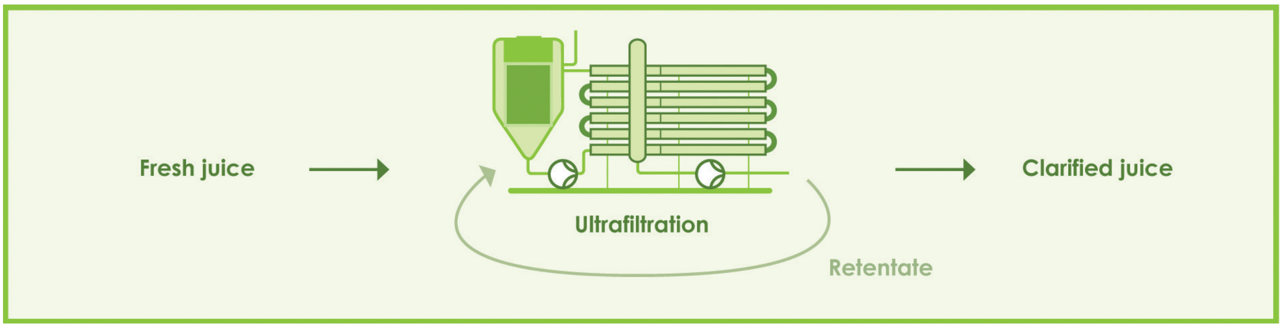

Fig. 1: Simplified crossflow filtration process

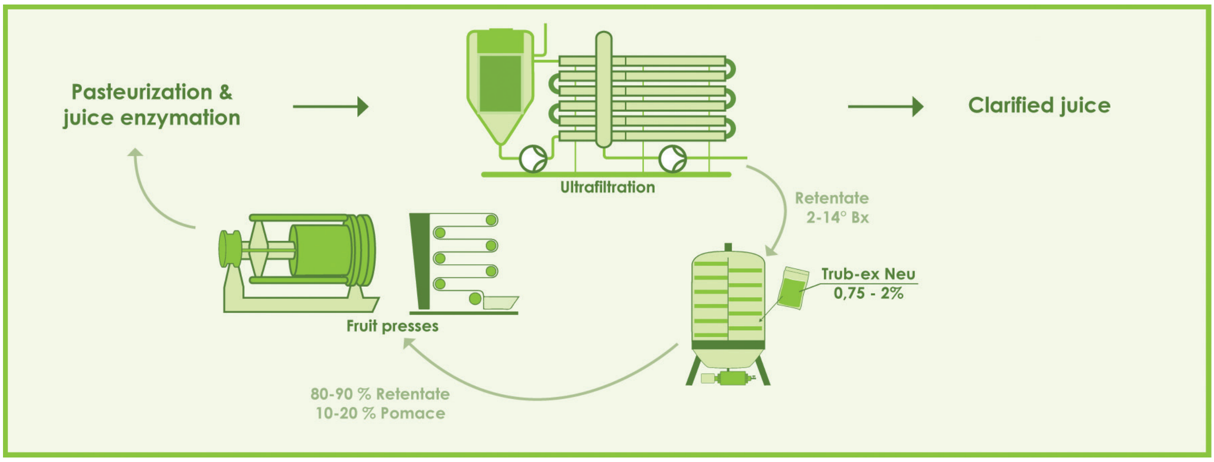

Fig. 2: Recovery of retentate using fruit presses

fruit juice concentrate plant can use several tens of thousands of litres of water daily during the season, most of which has to be specially treated. After use, the water then has to be evaporated, which is expensive in terms of cost and energy use. It should also be considered that the filtration system is unproductive during diafiltration. It is merely there to shore up a weak spot in the process. As filtration usually represents the bottleneck in concentrate production, this constitutes a good reason to develop an alternative approach.

A new way to treat retentate

In principle, even the most difficult liquid media usually have to be at least roughly clarified using suitable filter materials. With the product Trub-ex Neu, Erbslöh Geisenheim has created a specially prepared cellulose fibre as a pressing aid for this purpose. This fibre has a unique length and the end shows a fibrillated shape, which means it can absorb a relatively large volume of liquid. At the same time a balanced drainage system forms in the press cake. It is now possible, with this effective tool, to use the pomace that accumulates during operation as a coarse filter matrix for retentate, whether in concentrated form or after diafiltration. First a small proportion of Trub-ex Neu is mixed directly into the retentate. This suspension is now mixed with pressed pomace and squeezed out (Fig. 2).

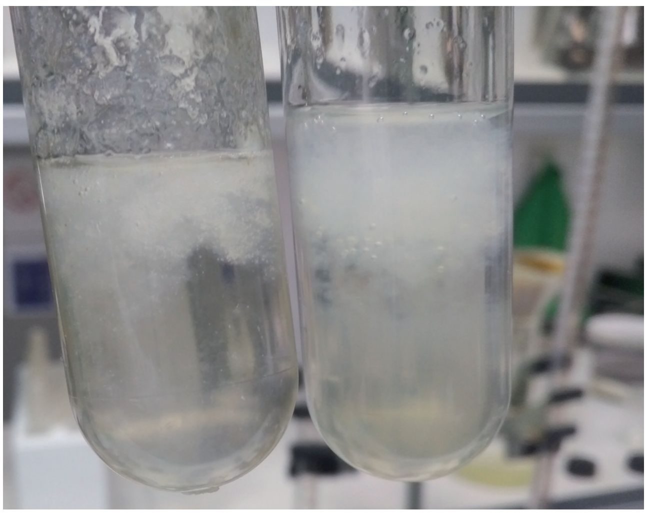

Fig. 3: Strongly positive pectin test in retentate (left)

The application's aim is to reduce drastically the proportion of solids in retentate, and largely completely retain solids of non-fruit origin, such as activated carbon or bentonite. Particular attention to the pectin test before juice clarification is significant here. Inadequate enzymation ultimately leads to intensification of a problem; recycling then only works with difficulty and uneconomic dosages of Trub-ex Neu (Fig. 3).

Initial results

The application was first tested to technical centre standard in multiple small-scale trials. This confirmed unproblematic pressing and cleaning of the press filter elements. The specimen data are for a leached apple juice retentate from an industrial process. This also included activated

Tab. 1: Retentate pressing with various proportions of pomace and Trub-ex Neu

Addition to retentate	Turbidity [NTU]t	Sediment [g]	Reduction in solids [%]t
Control	920	29.5	0
20 % pomace	780	14.2	52.0
10 % pomace + 1,5 % Trub-ex Neu	**720**	**12.6**	**57.0**
20 % pomace + 1,5 % Trub-ex Neu	**730**	**6.6**	**77.3**

Tab. 2: Checklist for retentate treatment with Trub-ex Neu

	Classic processing (e. g. by rotary filter)	Trub-ex Neu recycling
Product losses	Potentially high without diafiltration	Negligible
Time required	At least 5 h for 20 m^3 Diafiltration and slow filtration	1 h for 20 m^3
Retention of sediment & foreign particles	Yes	Yes
Additonal labour	Yes: Filter preparation and cleaning	No
Infection risk	Very high: long waiting times	Low: rapid process
Costs	At least EUR 40 per m^3	Approx. EUR 20 per m^3
Disposal	Direct discharge	Direct discharge Cattle fodder Biogas CHP plant Pectin recovery

carbon, which it was possible to separate out well, with the exception of unavoidable ultrafine particles. The particularly high reduction in sediment through the use of Trub-ex Neu is striking. In this stage the retentate turbidity is scarcely affected, as this predominantly consists of very fine particles (Tab. 1).

The next stage towards the process on an industrial scale was processing of chokeberry juice retentate. Many practitioners would describe this as the worst case scenario. It was possible to rework sour cherry (stoned and unstoned) and strawberry retentates without problem. The new process also proved its worth from the outset for retentates that had only been flushed through a little or even undiluted coloured juice retentates. Recovery of the majority of the valuable pigments also succeeded using an alternative method. The filtration system is immediately available again for productive use and is not blocked by diafiltration. The degree of extract and colour recovery is far superior to previous processing technologies in terms of effectiveness and performance, for minimal investment.

Summary

The use of Trub-ex Neu opens up completely new opportunities to the user where organisation of fruit juice filtration and the associated substeps are concerned. The retentate vessel can be emptied more frequently due to rapid reworking of relatively large volumes. As a result, the system's filter flow rate can be maintained at a high output level for a very long time. The valuable pigments are also recovered more effectively (Tab. 2).

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