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**CROSSPURE® - AN INNOVATION WITH CLEAR ADVANTAGES**

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**EXECUTIVE SUMMARY**

Crosspure® is a newly developed filter aid consisting of cross-linked PVP (PVPP), which is known for its excellent stabilisation capabilities, and polystyrene, that is approved for food contact and widely used e.g. in plastic cups. In contrast to powder-free filtration technology, which implicates a fundamental CAPEX, Crosspure® can be used in existing, slightly modified kieselguhr filter lines. Moreover this new filtration aid is regenerable, eco friendly and cost effective as transport and stock management can significantly be reduced.

The new filtration aid reaches firstly a high mechanical and secondly a high chemical stability, which highly helps to reduce the arising losses during application.

The innovative filtration aid Crosspure® is intended to be used as a regenerable replacement of Kieselguhr to remove suspended particulates from beverages. These particles include microorganisms and haze causing substances like polyphenols and polyphenol-protein complexes. Depending upon the product grade the catechin adsorption rate shall be more than 20 per cent (Table 1).

Parameter	Crosspure F	Crosspure XF
Swelling volume [l/kg]	< 3,5	< 3,5
Permeability [l/h x 1600 cm <sup>2</sup> ]	70 -120	30 - 60
Catechin adsorption [%]	10 - 25	20 - 35

Table 1: Application properties of Crosspure®

Just like PVPP, Crosspure® can be regenerated in a combined regeneration and filtration system. The losses arising from continuous dosing and according regeneration process are below 1.0 per cent.

Figure 4 shows the distribution of PVPP (red colour) and Polystyrene (green) of a Crosspure® particle by using Confocal Laser Scanning Microscope (CLSM) technology. CLSM is being used for quality control during production. The black areas are pores.

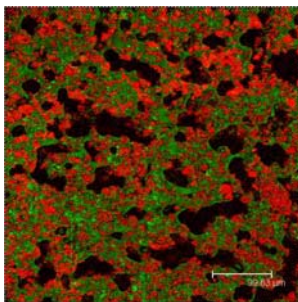


Figure 4: CLSM Photo of Crosspure®

**INTRODUCTION**

Kieselguhr or diatomaceous earth (DE) is a natural filtration aid used during the beer filtration process and afterwards disposed as waste, which is known to be hazardous to the environment. The eventual reprocessing of kieselguhr was investigated but it is considered to be quite laborious and expensive. DE is generally disposed as landfill material or, after regulative changes took place, on industrial waste dumps. Because of the high disposal costs there is an interest in finding more economic methods to replace kieselguhr for beer filtration.

The current annual worldwide consumption of DE of the brewing industry is approx. 180,000 tons, which has to be disposed as DE slurry after the filtration process. Kieselguhr as a non-renewable raw material has limited sources and so will not encourage environmental sustainability.

Crosspure® (Figure 1) is a newly developed BASF product that can be used for optimum filtration and stabilisation of alcoholic and non-alcoholic beverages in general.

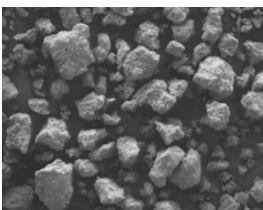


Figure 1: Morphology of Crosspure® F (SEM)

Crosspure® is intended to be used as a regenerable replacement of Kieselguhr to remove suspended particulates from beverages. Moreover this new filter aid will have positive effects on the environment and further will help to reduce waste dump resources and accordingly disposal costs.

**TECHNICAL DESCRIPTION**

Crosspure® is manufactured by a patented compounding process of a mixture of Polystyrene and cross-linked Polyvinylpyrrolidone (PVPP), which is known for its excellent stabilisation capabilities. Crosspure® is available in two grades, Crosspure® F and Crosspure® XF. Particle size distributions of both products are shown in figure 2 and 3, respectively.

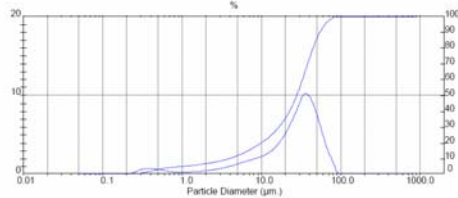


Figure 2: Particle size distribution of Crosspure® XF (Malvern)

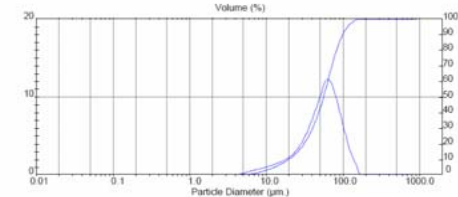


Figure 3: Particle size distribution of Crosspure® F (Malvern)

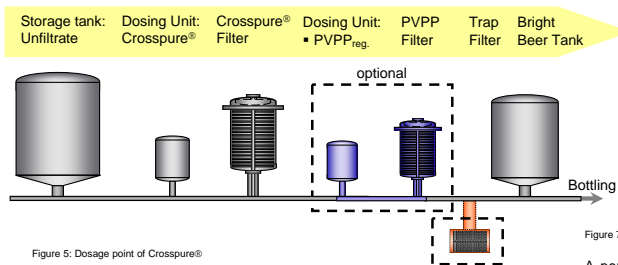


Figure 5: Dosage point of Crosspure®

**FILTRATION TRIALS**

**• Preparation**

A small candle filter (Table 2) was used to evaluate the filterability of beer of each brewery to define the proper blend of Crosspure®, which then was dosed as both pre-coating and body feed.

Type of filter candle	Stabox L0.5
Filtration area	0,070 m <sup>2</sup>
Vessel volume	3.0 litre
Filtration capacity	30 litre per hour

Table 2: Main description of lab candle filter

**• Pilot Scale Trial**

In pilot scale tests the pre-coat amount was determined at approx. 2,000 g/m<sup>2</sup>. The current dosage will vary between 50 - 200 g/hl, depending upon the 'normal' usage of kieselguhr by each brewery.

In various tests it could be shown that the delta pressure ( $\Delta P$ ) increase is below 0,3 bar per hour. Analytical results of the filtered beers are shown in table 3.

Sample	Wort [°P]	Colour [EBC]	pH	Alcohol [Vol.-%]	Foam [Nibem-s]
Unfiltrate	13.04	7.5	4.36	5.84	329
Aft. 1 hrs	12.85	6.1	4.39	5.75	363
Aft. 2 hrs	12.62	6.2	4.40	5.62	390
Aft. 3 hrs	12.7	6.3	4.41	5.65	394
Aft. 4 hrs	12.86	6.6	4.41	5.73	340
Aft. 5 hrs	12.84	6.4	4.41	5.71	382

Table 3: Analytical results

**• Stability Test**

The non-abrasive effect of Crosspure® was checked in pilot scale to demonstrate the mechanical stability of the product. The 'stress-tests' were simulated with stirrer, dosing pump and accordingly many fold regeneration cycles. A dosing pump test, simulating 80 filtration runs, is shown in figure 6.

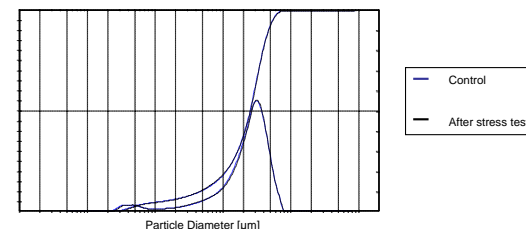


Figure 6: Stability test with Crosspure® XF

**• Commercial Trial**

Meanwhile commercial tests were carried out in both horizontal leaf and candle filters. The filter areas were 2 m<sup>2</sup> and 8 m<sup>2</sup>, respectively. Hourly outputs were 10 and accordingly 40 hectolitres.

A view of a partially Crosspure® coated filter candle is demonstrated in figure 7.



Figure 7: Filter candle coated with Crosspure®

A performance diagram of a Crosspure® filtration is documented in figure 8. The installed test candle filter consists of a manually controlled Crosspure® dosing pump, an inline photometer and accordingly pressure meter. The test filter is run as by-pass to the existing 600 hl DE filtration line to receive real comparison results. The unfiltered high gravity beer is transferred to the filter line without a pre-clarification (separator) step.

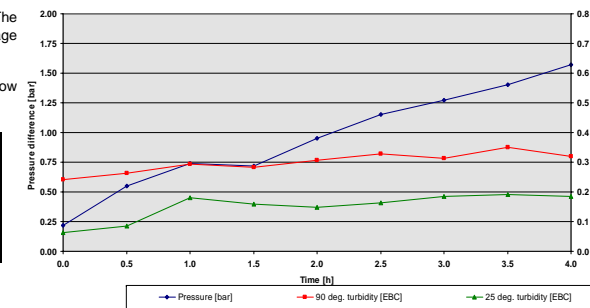


Figure 8: Filtration diagram

**• Trial Results**

Within the years 2004 and 2005 various filtration tests were carried out and the results were very promising. It could be shown that Crosspure® is suitable for both horizontal leaf and candle filters. The final beer quality remains unchanged and the target stabilisation effect could be reached.

Table 4 shows analytical results of Crosspure® filtered beers of time frame September through November 2005. Compared to standard DE treated beer, all Crosspure® filtered beer batches completely passed the breweries sensory requirements.

Orig. gravity [P]	Alcohol [G%]	pH	O <sub>2</sub> [g/l]	Turbidity 90 deg. EBC	Turbidity 25 deg. EBC
11.84	3.88	4.21	0.04	0.36	0.36
11.74	3.76	4.22	0.01	0.24	0.11
11.88	3.85	4.14	0.06	0.21	0.06
11.78	3.85	4.15	0.08	0.37	0.16
11.81	3.84	4.17	0.06	0.22	0.19
11.96	4.08	4.19	0.04	0.28	0.41

Table 4: Analytical results

**APPROVAL SITUATION**

The German Food Safety Act (LMBG) § 11, in accordance with the EU directive 89/107/EWG #1 describe processing aids as any substances not consumed as a food ingredient itself, intentionally used in the processing of raw materials, foods or their ingredients, to fulfil a certain technological purpose during treatment or processing and which may result in the unintentional but technical unavoidable presence of residues of the substance or its derivatives in the final product, provided that these residues do not present any health risks and do not have any technological effect on the finished product. As a result, processing aids do not have to be approved by the Germany authority, it is in the responsibility of the processor to assess and ensure the safety. It can be expected that Crosspure will get its US-FDA approval in the first half of 2006. Approvals of various countries of the Asia-Pacific region are ongoing.

**SUMMARY**

BASF's new beverage filter aid Crosspure® has significant benefits in comparison with existing conventional products, primarily because it is regenerable, easy to use, cost effective, synergistic balanced and last but not least eco friendly.

**ACKNOWLEDGMENT**

BASF would like to thank all Crosspure® involved European breweries for their kind support and co-operation.