COEI-1-PLAQFI Depth filter sheets

1. Objective, origin and scope of application

Depth filter sheets, belonging to the family of porous filter materials, are composed of organic and/or inorganic materials, and are generally used for clarification and/or microbiological stabilisation of liquids; their geometrical shapes are specific to the filtration systems defined by the manufacturers.

2. Principle

Filtration with depth filter sheets is a physical separation process that is applied to particles ranging from 0.1 to 40 µm, allowing for the retention of bacteria, yeasts, other microorganisms and particles. The retention of the particles is based on a process of interception and adsorption within the depth filter sheets (trap deep within the sheet), and to a lesser extent a sieve effect at the outer surface, while the fluid passes through the sheets under the action of a pressure gradient. Depth filter sheets are characterised by their permeability and retention rate, which allow for different types of filtration: coarse, clarifying, or sterilising.

The treatment of musts and wines by filtration is described in the OIV *International Code of Oenological Practices*.

Filtration with depth filter sheets is carried out with filter apparatus and/or lenticular module housings and a feeding pump. Normally the filtration process is ended when a differential pressure of 300 kPa (3 bar) is reached. For filtration performance reasons, a differential pressure of 150 kPa (1.5 bar) should not be exceeded in applications for separating microorganisms, which should be conducted under constant flow conditions.

3. Composition

Depth filter sheets are manufactured using raw materials specially selected for purpose, such as purified, bleached and finely fibrillated cellulose fibres from deciduous and coniferous trees, as well as different quantities of organic and inorganic filter aids like diatomaceous earth, perlite, zeolites, silicates, PVPP, synthetic wood pulp, activated carbon and/or other OIV-reviewed compounds. Polyamidoamine polymers are used as wet strength agents to improve the tensile properties in both wet and dry states, by crosslinking the cellulose fibres with covalent bonds that do not break upon wetting. The wet strength agent content should not exceed 4% of the dry fibres in the finished product. The main components and their monographs are listed in the OIV *International Oenological Codex*. Wet

strength agents are approved for usage in hot- and cold-water filter papers[1].

4. Labelling

The main product characteristics such as filter grade, size and batch number should be indicated on the label.

5. Manufacture

A slurry of the above-mentioned compounds is dewatered on a wire belt with vacuum, and afterwards dried in an oven.

Through a number of procedures (refining/grinding/fibrillating) performed on the cellulose and the use of different inorganic filter aids, it is possible to obtain a whole range of permeabilities and retention rates (from 0.1 to 40 µm).

The depth filter sheets' final characteristics (thickness, porosity, pore size, flow rate, microorganism reduction, adsorption) depend on a great number of parameters (choice of cellulose fibres from deciduous and/or coniferous trees, amount and type of inorganic material, dewatering, temperature, etc.).

Depth filter sheets can be produced in any geometrical shape using die cutting or water jet cutting and used as flat sheets, or in lenticular filter modules, capsules or other products.

6. Depth filter sheet rinsing and sterilisation

Depth filter sheets should be flushed with water before the first filtration, according to the manufacturer's instructions. After rinsing, the rinse water should be disposed of according to the local regulations in force. Depth filter sheets can be sterilised with hot water (85 °C) or inline steam (125 °C to max. 134 °C). In both cases, rinsing should be carried out for at least 20 minutes.

7. Regeneration/Backwashing

When the maximum differential pressure is reached, a regeneration of the filter sheets can be performed. Depending on the nature of the blocking particles, it may be possible to extend the life of the filter with this procedure.

To regenerate the filter sheets, rinse them with cold water (15-20 °C) in the direction of filtration flow for approx. 5 minutes, then rinse with hot water (60-80°C) in the opposite direction of filtration flow for approx. 10 minutes. It is not recommended to perform more than 5 regeneration cycles per filter sheet. It is however recommended, for bacteriological safety reasons, to replace filter sheets no more than 4 weeks after their first use.

8. Disposal

Local waste-sorting guidelines should be complied with when disposing of depth filter sheets. In principle, used filter sheets are biodegradable[2]. Ensuring the local regulations in force are followed, these can be disposed of as normal domestic waste for landfill or destroyed by thermal processes. This is provided that the depth filter sheets have not come into contact with any toxic substances during the filtration process. This statement is also applicable for depth filter sheets used in lenticular filter modules or other systems.

9. Tests

All of the equipment (depth filter sheets, lenticular filter modules, or other parts and products of the filter system) in contact with food products must comply with the following limits.

There should be no noticeable change in the sensory (organoleptic) characteristics of the musts and wines if the depth filter sheets are used and handled according to the recommendations of the manufacturer.

The limits are determined according to values observed from use of depth filter sheets made in accordance with good manufacturing practices.

9.1. Dry matter content in an aqueous extract

The products can be used as hot- and cold-water filter papers and filter layers for foodstuffs.

Determine the dry matter, after pre-flushing the depth filter sheet with a volume of 50 L/m^2 before extraction, according to the following standards:

- the total quantity of extractables (hot water)[3] [4] should be less than 10 mg/g,
- the total quantity of extractables (cold water)[5] should be less than 5 mg/g,
- the total quantity of all organic extractables should be less than 2 mg/g.

9.2. Chloropropanol content

The 1,3-dichloro-propan-2-ol (DCP) and 3-monochloropropane-1,2-diol (MCPD) content is determined in the cold/hot water extract after pre-flushing the depth filter sheet with a volume of 50 L/m^2[2][4].

The quantification of DCP and MCPD[6] is performed after the separation of the analytes in the water extract using a solid-phase extraction column. The DCP and

MCPD are derivatised using heptafluorobutyrylimidazole (HFBI) and determined by GC-ECD chromatography.

9.2.1. 1,3-Dichloro-propan-2-ol (DCP) content

Proceed with determination as in point 9.2,

the 1,3-dichloro-propan-2-ol (DCP) content must be lower than 2 µg/L in a cold/hot water extract.

9.2.2. 3-Monochloropropane-1,2-diol (MCPD) content

Proceed with determination as in point 9.2,

the 3-monochloropropane-1-2,-diol (MCPD) content must be lower than 12 µg/L in a cold/hot water extract.

9.3. Soluble metal and heavy metal content

The soluble metal content, as for that of heavy metals, is always determined in the extract after pre-flushing the depth filter sheet with a volume of 50 L/m^2. For extraction, acetic acid is used at 5% (p.a.).

Extraction procedure:

- place the filter holder horizontally, and for better ventilation, position the filter bottom-up,
- volumetric flow rate: $V = (500 \pm 50) L\, m^{-2}\, h^{-1}$
- initial volume: 25 $L\, m^{-2}$,
- continuously pump the initial volume in a closed system, until a volume of 100 L m^{-2} has been passed through the depth filter sheet (since V = 500 $L\, m^{-2} h^{-1}$, the duration of filtration is exactly 12 minutes),
- in case of dripping, collect the drips and add them back into the overall volume after filtration,

once the filtration time has elapsed, stop the elution; do not drain the filter under pressure.

9.3.1. Heavy metals

The determination of heavy metals (mg metal per kg depth filter sheet) is carried out in the extract using atomic absorption spectrometry (flame/graphite furnace):

proceed with extraction as described in point 9.3,

the extractible heavy metal content[7] should be less than 50 ppm.

9.3.2. Iron

proceed with extraction of the iron as described in point 9.3,

determine the corresponding concentration of cations in the filtrate,

the iron content is determined according to the method described in Chapter II of the *International Oenological Codex*,

the iron content should be less than 300 mg/kg.

9.3.3. Lead

proceed with extraction of the lead as described in point 9.3,

determine the corresponding concentration of cations in the filtrate,

the lead content is determined according to the method described in Chapter II of the *International Oenological Codex*,

the lead content should be less than 5 mg/kg.

9.3.4. Mercury

proceed with extraction of the mercury as described in point 9.3,

determine the corresponding concentration of cations in the filtrate,

the mercury content is determined according to the method described in Chapter II of the *International Oenological Codex*,

the mercury content should be less than 1 mg/kg.

9.3.5. Arsenic

proceed with extraction of the arsenic as described in point 9.3,

determine the corresponding concentration of cations in the filtrate,

the arsenic is determined according to the method described in Chapter II of the *International Oenological Codex*,

the arsenic content should be less than 3 mg/kg.

9.3.6. Cadmium

proceed with extraction of the cadmium as described in point 9.3,

determine the corresponding concentration of cations in the filtrate,

the cadmium is determined according to the method described in Chapter II of the *International Oenological Codex*,

the cadmium content should be less than 1 mg/kg.

10. Special restrictions

Depth filter sheets, lenticular filter modules and all other components and products must meet the regulatory requirements for equipment in contact with food.

11. Storage conditions

Depth filter sheets consist of highly adsorbent materials. This product must be handled carefully during shipping and storage. Store the depth filter sheets in their original packaging in a dry, odour-free, and well-ventilated area. Do not expose the depth filter sheets to direct sunlight. When stored correctly, filter sheets do not degrade. According to the manufacturers, it is recommended to use filter sheets within 5 years after purchase.

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[1] According to the respective recommendations and standards of the BfR (Germany) and FDA (United States), the GB 9685 standard, and other codes relating to foodstuffs, common consumption products and animal feed.

[2] According to standard EN 13432:2000 (composting and biodegradation).

[3] According to standard EN 647:1993 (hot water extract).

[4] According to standard EN 920:2000 (determination of dry matter content in an aqueous extract).

[5] According to standard EN 645:1993 (cold water extract).

[6] According to paragraph 35 of the LMBG (German law on foodstuffs and common consumption products), method 80.56-2.

[7] According to recommendation XXXVI/1 of the German Federal Institute for Risk Assessment (BfR).