BIO-BLOK® INTELLIGENT FIXED FILM BIOLOGICAL FILTER MEDIA

2.1.4. DIN 19 557, Part 2 (November 1989)

Wastewater Treatment Plants
Filter Media Made of Plastic for Trickling Filters
Requirements and Tests

Given below you will find a transcript of the German Norm DIN 19 557, Part 2 (November 1989).

After each section of the norm we have framed the most important pieces of information about the BIO-BLOK®.

1. Field of application

The norm in question applies for filter media made of plastic for trickling filters used for biological treatment of waste water. Filter media made of plastic can be constructed as arranged filter media (block material), irregular filter media (loose filled up media) and as suspended filter media - subsequently called filter media.

The BIO-BLOK® filter media is constructed as block material. Depending on the customer's requirements and requests, the BIO-BLOK® products can be produced in different heights.

2. Field of insert

The selection of the differently developed filter media is determined by the organic loads that are expected for trickling filters (BOD5 surface and area loads respectively) and the hereby determined operation conditions.
The trickling filter is divided into 3 load steps (please see table 1).

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Table 1: Field of insert		
Load step	**BOD5 - Surface load g/(m2 x d) *)**	**BOD5< - Volume load kg/(m3 x d)**
Small load	≤ 4	≤ 0.5
Middle load	≤ 15	≤ 2
Heavy load	> 15	> 2
*) referred to the active surface (growth surface)		

BIO-BLOK® filter media

The BIO-BLOK® filter media is constructed of polyethylene net tubes that are welded together in the tube ends. The net tubes are made of rough oval strings that together form the holes of the net tubes. Depending on the filter type, the holes are either big or small.

When the biofilm grows on a level surface, the biological active area will never become bigger.

When the biofilm grows on an oval or round surface such as the BIO-BLOK® products, the diameter of the net strings grows and the biological active area then grows with increasing load.

Below is listed the type of BIO-BLOK® that should be used:

Table 2: BIO-BLOK® filter media		
Load step	**Filter media**	**Active surface *)**
Small load	BIO-BLOK 200	200 - 400 m2
Middle load	BIO-BLOK 150	150 - 350 m2
Heavy load	BIO-BLOK 100	100 - 350 m2
**) Please note that the active surface calculations are based on different thickness of biofilm.*		

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3. Requirements

3.1. Chemical qualities

3.1.1. Resistance to chemical and biological influences

The filter media have to be resistant to chemical and biological influences of all types of waste water, and they have to be biochemical inert.

Comments:

The following raw materials (elements) are suitable for this purpose -
Polyvinyl chloride (PVC), Polyethylene (PE) and Polypropylene (PP).

The BIO-BLOK® filter media is made of polyethylene and is therefore resistant to chemical and biological influences of all types of waste water.

3.1.2. Resistance to influences from ultra-violet radiation (UV radiation)

The filter media have to be resistant to influences from UV radiation. A considerable UV radiation can occur by stocking and transport.

The BIO-BLOK® filter media is resistant to influences from UV radiation.

3.1.3. Combustibility

The raw material used for filter media is combustible; therefore, safety regulations for fire prevention have to be complied with.

3.2. Physical qualities

3.2.1. Load capacity

The necessary load capacity of the filter media is decided by the loads that arise during operation by the weight of the filter media, sludge and waste water. The working load per m2 is heterogeneous over the filling height. The working load is decided by the organic load, hydraulic participation, washing power and form and structure of the filter media.

Remark:
By the filter media's suitability for the foreseen performance field (see table 1) and by prescribed operation (e.g. prevention of suspension), the working load is empirically between 2 and 5 kN/m3.

The load capacity of the filter media should be stated by determination of the maximum filling height without middle support constructions from the producer.

All producers/tenderers have to guarantee the necessary load capacity of their filter for the performance field in question. However, the following load capacity values have at least to be provide:

T_{nec} = h x A x f x s in kN/m²

This means:

T_{nec} = necessary minimum load capacity in kN/m2

h = filling height in m

A = the producer's stated theoretical surface in m2/m3

s = safety factor, here s = 1.5

f = factor for the weight load through the biofilm (with regard to the theoretical surface) depends on the thickness of the biofilm

Table 3: Factor for weight load

Thickness of biofilm in mm	Factor for the weight load f in kN/m2
1.5 for small load	0.015
2 for middle load	0.02
≥ 3 for heavy load	≥ 0.03

In the following table the maximum load capacity for our BIO-BLOK® filter media is stated as a value without side support. If it is possible to establish side support or if the filter media are "locked", it is possible to increase the maximum load capacity by approx. 28-35%.

Table 4: Load step: Small load (1.5mm biofilm thickness)

		Minimum load capacity in kN/m2 by different filter heights						
Filter media	**Maximum load capacity without side support kN/m2**	**2m**	**3m**	**4m**	**5m**	**6m**	**7m**	**8m**
BIO-BLOK 100	22.69	4.50	6.75	9.00	11.25	13.50	15.75	18.00
BIO-BLOK 150	62.23	6.75	10.12	13.50	16.87	20.25	23.62	27.00
BIO-BLOK	77.79	9.00	13.50	18.00	22.50	27.00	31.50	36.00

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200								

Table 5: Load step: Middle load (2mm biofilm thickness)								
		Minimum load capacity in kN/m2 by different filter heights						
Filter media	**Maximum load capacity without side support kN/m2**	**2m**	**3m**	**4m**	**5m**	**6m**	**7m**	**8m**
BIO-BLOK 100	22.69	6.00	9.00	12.00	15.00	18.00	21.00	
BIO-BLOK 150	62.23	9.00	13.50	18.00	22.50	27.00	31.50	36.00
BIO-BLOK 200	77.79	12.00	18.00	24.00	30.00	36.00	42.00	48.00

Table 6: Load step: Heavy load (3mm biofilm thickness)								
		Minimum load capacity in kN/m2 by different filter heights						
Filter media	**Maximum load capacity without side support kN/m2**	**2m**	**3m**	**4m**	**5m**	**6m**	**7m**	**8m**
BIO-BLOK 100	22.69	9.00	13.50	18.00	22.50			
BIO-BLOK 150	62.23	13.50	20.25	27.00	33.75	40.50	47.25	54.00
BIO-BLOK 200	77.79	18.00	27.00	36.00	45.00	54.00	63.00	72.00

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Table 7: Load step: Heavy load (4mm biofilm thickness)								
		Minimum load capacity in kN/m2 by different filter heights						
Filter media	**Maximum load capacity without side support kN/m2**	**2m**	**3m**	**4m**	**5m**	**6m**	**7m**	**8m**
BIO-BLOK 100	22.69	12.00	18.00					
BIO-BLOK 150	62.23	18.00	27.00	36.00	45.00	54.00		
BIO-BLOK 200	77.79	24.00	36.00	48.00	60.00	72.00		

3.2.2. Heat stability

When selecting filter media, effect temperatures over 30°C have to be considered individually (e.g. industrial waste water, closed building constructions). The supplier has to specify these individual temperature conditions.

The BIO-BLOK®> filter media stands waste water temperatures up to 80°C.

3.2.3. Settlement

The filter media are influenced by a load and material depending settlement. After six months' operation with keeping of the laid down operation conditions, the filling height by arranged filter media may be maximum 1% and by irregular filter media maximum 3% under the dimensioned filter height. In connection with irregular filter media, settlement losses can be set off through overfilling.

The BIO-BLOK® filter media are available in heights according to the customers' requests. I.e. settlements that occur under normal load can be included in the requested filter height. Thus it is possible to reach the requested filter height under full load.

3.3. Insert technical qualities

3.3.1. Surface in connection with volume and weight

The theoretical surface indicates the sum of all material surfaces of the filter media. Thus the surface roughness and the micro pore structure stay unnoticed. With regard to volume, the theoretical surface is stated in m2/m3 and with regard to weight in m2/kg.

Depending on form and materiel, you get different sizes of surface by production of filter media per kg made material.

For the surface/weight conditions, the following standard values apply for arranged and irregular filter for the specific surface:

* Polyethylene, Polypropylene - 1.5 to 5 m2/kg
* PVC, deep drawn - 2 to 3.5 m2/kg
* PVC, extruded - 3 to 6 m2/kg

Deviations from the standard values might influence the load capacity and the insert technical qualities.

The surface/weight conditions of the BIO-BLOK® filter media are calculated from dry condition:

* BIO-BLOK 100	100 m2/m3	2.66 m2/kg
* BIO-BLOK 150	150 m2/m3	2.94 m2/kg
* BIO-BLOK 200	200 m2/m3	3.33 m2/kg

3.3.2. Active surface and utilisation factor

By the active surface (growth surface) is meant the surface that is wet during operation. With regard to size, the biological active growth surface can differ from the active surface depending on the operation conditions.

The utilisation factor is defined as the proportion between the active surface and the theoretical surface. This is influenced by:

* the volume related theoretical surface
* form and structure of the filter medium
* the hydraulic participation
* type and concentration of the wastewater content

Table 8: Active surfaces					
		Biofilm thickness			
Filter media	**Dry condition**	**1mm**	**2mm**	**3mm**	**4mm**
BIO-BLOK 100	100 m2/m3	165 m2/m3	233 m2/m3	299 m2/m3	366 m2/m3
BIO-BLOK 150	150 m2/m3	268 m2/m3	387 m2/m3	507 m2/m3	
BIO-BLOK 200	200 m2/m3	312 m2/m3	426 m2/m3		

Table 9: Utilisation factors					
		Biofilm thickness			
Filter media	**Dry condition**	**1mm**	**2mm**	**3mm**	**4mm**
BIO-BLOK 100	100 m2/m3	1.65	2.33	2.99	3.66
BIO-BLOK 150	150 m2/m3	1.78	2.58	3.38	
BIO-BLOK 200	200 m2/m3	1.56	2.13		

3.4. Technical requirements for construction

3.4.1. Filter media

Filter media for arranged packing are normally produced with a height of 0.6m; it is possible to halve them for comminution. The filling height of the trickling filter thus makes a multiple of 0.3m. The total filling height by arranged packing may not exceed 6m.

By irregular filter media, the filling height is generally between 2m and 5m. By suspended filter media, the filling height is generally between 4m and 8m.

The BIO-BLOK® filter media can - according to the customers' requests - be produced in heights from 45cm to 75cm. Thus the requested filter height is always available.

The maximum filter height can - depending on the load step, side support if any, and type of filter media - be built higher than 6m.

3.4.2. Working load in connection with repairs

Only in exceptional case should the trickling filter be set foot on. Measures against movements and damage to the filter media should be made according to local requirements.

According to DIN 19 553, an operation footbridge is necessary for maintenance works of e.g. the spreader.

The BIO-BLOK® filter media stand to be walked on in connection with e.g. repair works. This is also the case when installing BIO-BLOK®.

If the customer requires an assembled coherent trickling filter media, the BIO-BLOK® filter media can be locked together so that the entire filter media functions as a unit.

3.4.3. Carrier grating

By arranged filter media, the free passage of the carrier grating should be at least 50% of the base.

The carrier surface should be made horizontally.

By irregular filter media, the opening of the carrier grating is determined based on the size of the individual filter media. In that way the free passage of the carrier grating makes 25% of the base of the trickling filter.

3.4.4. Calculation of the carrying constructions

Due to safety reasons, for calculation of the carrying constructions and/or bottom grating bigger operation loads than 5 kN/m3 shall be laid down depending on the building construction, clogging risks, and storing of the filter media.

4. Tests

As long as suitable test methods are lacking, the requirements are considered to be met when the filter media after 2 years' unchanged operation in accordance with the operation requirements comply with the resulting functions according to the mentioned qualities.

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