

## FILTERMATERIAL .....

### DIE RICHTIGE AUSWAHL

Dieser Bericht ist eine Zusammenfassung über Filtermaterialien, die normalerweise in der Druckfiltration für Haushalt und Industrie eingesetzt werden. Unterschieden wird hierbei in Anwendung und Betriebsparameter, sowie einer kurzen Beschreibung der Produkte. Für grundsätzliche Unterschiede der Filtermaterialien verweisen wir auf Tabelle 1, für einen Vergleich der Filtermedien auf Tabelle 1. Es gibt natürlich noch andere Filtermaterialien doch würde dies den Rahmen der Zusammenfassung sprengen.

#### **Anthrazit**

Anthrazitkohle ist ein körniges und ideales mittelgewichtiges Filtermaterial. Durch die ungleichmäßige Form dringen die Partikel und die Elemente tiefer in das Bett und ermöglichen somit eine Tiefenfiltration mit längeren Filterstandzeiten. Anthrazit wird oft genutzt in Multi-Media Filtern oder in Doppel-Schicht Filtern.

Schüttdichte	(kg/dm <sup>3</sup> ):	0,80
Betthöhe	(mm):	600 – 900
Filtergeschwindigkeit	(m/h):	12,5
Rückspülgeschwindigkeit	(m/h):	30 - 45

#### **Birm®**

**Birm®** ist ein künstlich erzeugtes Filtermedium, beschichtet mit Mangandioxid. Es wirkt als leichtgewichtiges Filtermaterial, katalytisch oxidierend. Diese katalytische Aktivität ergibt sich zwischen gelöstem Sauerstoff im Wasser und Schwermetallen wie Eisen und Mangan. Die chemische Reaktion zwischen beiden verursacht, dass Eisen und Mangan ausfallen ( Wechsel von gelösten zu partikulären Eisen ) und die Partikel dann an der Oberfläche des **Birm®** Materials absorbieren.

Seite - 2 -

Schüttdichte	(kg/dm <sup>3</sup> ):	0,75
Betthöhe	(mm):	750 - 900
Filtergeschwindigkeit	(m/h):	8 - 13
Rückspülgeschwindigkeit	(m/h):	25 - 30

### **Manganese Greensand**

Manganese Greensand ist ein natürlich vorkommendes glaukornmittischer Sand, beschichtet mit Mangan, was dem Filtermaterial eine dunkel-schwarze Farbe verleiht. Angewendet wird Manganese Greensand zur Entfernung von Eisen, Mangan und Schwefelwasserstoff.

Greensand wird kontinuierlich regeneriert (CR) mit KMnO<sub>4</sub> (Kalium-Permanganat) und bzw. oder freien Chlor (z. B. Natriumhypochlorid). Es kann auch, wie normal üblich, diskontinuierlich (IR) regeneriert werden mit KMnO<sub>4</sub>.

Die Kapazitäten ergeben sich hier aus kontinuierlicher Regeneration mit 350 mg/l Filtermaterial. Wenn eine Regeneration mit 1,5 bis 3 g Kalium Permanganat / pro Liter Manganese Greensand angewendet wird. Dies unterstellt eine Ausfallbeteiligung von Eisen = 1:1,

Mangan = 1:2 und Wasserstoffoxid 1:4 ppm. Das bedeutet in der Praxis eine Entfernung, wenn Eisen alleine ist von 350 ppm, 175 mg/l Mangan alleine oder 90 mg Wasserstoffoxid allein. Die diskontinuierliche Regeneration gibt nur die Hälfte der Kapazität und resultiert in 175 mg/l. Es ist allgemeine Praxis eine Schichthöhe von 400 mm von Anthrazit auf den Greensand aufzuschütten bei kontinuierlichen Regenerationen

Schüttdichte	(kg/dm <sup>3</sup> ):	1,35
Betthöhe	(mm):	750 - 900
Filtergeschwindigkeit	(m/h):	5 - 12
Rückspülgeschwindigkeit	(m/h):	30 - 35
Regenerationslevel		1,5 – 3 g KMnO <sub>4</sub> / ltr MG

### **MTM<sup>®</sup>**

MTM ist ein künstlich erzeugtes Mangandioxid Filtermaterial, angewendet zur Reduzierung von Eisen, Mangan und Wasserstoffsulfid aus Wasser. MTM hat die gleiche Wirkungsweise wie Greensand und wird auch mit KmnO<sub>4</sub> und / oder freiem Chlor regeneriert. Die hauptsächliche Unterscheidung zwischen MTM und Greensand ist das spezifische Gewicht. Diese Gewichtseigenschaft reduziert die Rückspülraten und Differenzdrücke während des Betriebes.

Schüttdichte	(kg/dm <sup>3</sup> ):	0,44
Betthöhe	(mm):	600 - 900
Filtergeschwindigkeit	(m/h):	7,5 – 12,5
Rückspülgeschwindigkeit	(m/h):	20 - 25

### **Corosex<sup>®</sup>**

Corosex ist eine hoch reaktives Magnesiumoxid, eingesetzt zur Neutralisierung von freier Kohlensäure im Wasser. Es wird eingesetzt bei hohen Filtergeschwindigkeiten

Seite - 3 -

und / oder für große pH-Wert-Korrekturen. Begrenzt ist die Wirkung bei niedrigen Filtergeschwindigkeiten. In Wässern mit mittlerer und höherer Härte kann Kalzium ausfallen und dies Filtermedium verblocken.

Schüttdichte	(kg/dm <sup>3</sup> ):	1,60
Betthöhe	(mm):	600 - 700
Filtergeschwindigkeit	(m/h):	12 - 15
Rückspülgeschwindigkeit	(m/h):	25 – 30

**Tabelle 1, Filtermaterial Vergleich**

Material	Dichte kg/dm <sup>3</sup>	Service m/h	Delta p bar	Service max m/h	Delta p bar	Bett-höhe mm	Rückspülun m/h*	Einsatz	Limits
Anthrazit	0,80	12	0,1	12,5	0,1	600-900	35	Sediment	Gelöster Sauerstoff Härter & Alkalität Alkalität Chlorine Flow rate TDS>150, BW GPM TDS>150, BW GPM Regenerant Regenerant Dissolved oxygen BW GPM
Birm	0,75	8	0,1	13	0,1	750-900	25	Fe, Mn, H <sub>2</sub> S	
Corosex	1,60	12	0,1	15	0,15	600-700	25	Neutralisation	
Calcite	1,60	7,5	0,1	15	0,15	600-700	25	Neutralisation	
Filter AG	0,40	8	0,1	12	0,2	600-900	20	Sediment	
Garnet	2,25	12	0,15	25	0,1	250+	65	Sediment	
GAC CI	0,40	8	0,1	13	0,1	600+	20	Chlorine	
GAC Organ	0,40	2,5	0,1	7,5	0,1	900+	20	Organics VOCs	
KDF 55	2,75	35	0,1	75		250+	70	Chlorine, H.	
KDF 85	2,75	18		35		250+	70	Metalle	
Greensand	1,35	5	0,15	12	0,3	750-900	30	Fe, Mn, H <sub>2</sub> S	
MTM	0,44	7,5	0,1	12,5	0,1	600-900	20	Fe, Mn, H <sub>2</sub> S	
Multi-media	1,47	25	0,4	40	0,8	900+	35	Fe, Mn, H <sub>2</sub> S	
Pyrolox	2,0	12	0,1	15	0,1	600+	65	Sediment	
Sand	1,6	7,5	0,1	12	0,1	450-700	45	Fe, Mn, H <sub>2</sub> S Sediment	

\* Für Wasser von 15°C. Wärmeres Wasser benötigt eine kleinere r water requires smaller flow rate, colder requires a higher rate.  
Note: All flow rates are per m<sup>2</sup> of filter surface area. Multiply all values given by the filter tank m<sup>2</sup> value

**Figure 1. The Basic Mechanisms**

Filtration occurs in two mechanisms. The first is simply a sieving action for removal of suspended matter. Anything larger than the spaces between grains of media is trapped. Filter media removes suspended particles but also filter to a smaller micron size than the spaces between granules. Grains of filter media are typically in the 300-1. 700 micron size with spaces between them of 25 - 500 microns. The ability to filter to below the actual inter-particle space size is due to the surface of the filter media. This process is influenced by a number of variables including gravitational setting, diffusion, interception and hydrodynamics. These variables are in turn affected by physical properties such as filter size, filtrate rate, fluid temperature, density, size and shape of suspended matter. Also, don't forget electrostatic repulsive forces and Van der Waal's forces, whereby electrons correlate dipolar movement of subatomic particles affecting attraction. In addition, we use filter media that's formulated with additional characteristics including oxidation, reduction and neutralization. All filter media requires backwashing, some utilize a regenerant and many have water constituent limitations or requirements.

Seite - 4 -

As a consequence of the complexity of the filtration process, the service flow rates on product literature are estimates at best. Service flow must be matched to the adsorption criteria. Contaminants in water may have a low, medium or high surface area, thus affecting its ability to adsorb certain constituents. If the flow rate exceeds the design rate, poor filtration is likely. Backwash rates are designed to fluidize (lift) the filter bed based on the density of the filter media. Low backwash rates result in incomplete cleaning of the bed and premature failure of the filter. Backwash rates that are too high can result in the loss of filter media.

### **Pyrolox®**

Pyrolox is a mined ore (manganese dioxide) used for iron, manganese and hydrogen sulfide reduction. Pyrolox – like Birm, greensand and MTM – acts as a catalyst to oxidation. Waters low in dissolved oxygen cannot use the catalytic properties of Pyrolox. It doesn't require a regenerant but must be backwashed aggressively. Backwashing causes the media to abrade itself resulting in a new exposed surface. Inadequate backwash rates and low dissolved oxygen are the two primary causes of filter failure when using Pyrolox.

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	2,0
<i>Bed depth</i>	<i>(mm):</i>	600+
<i>Service flow</i>	<i>(m/h):</i>	12
<i>Backwash flow</i>	<i>(m/h):</i>	60 - 75

### **Filter-Ag® (Ag)**

Filter-Ag is a non hydrous silicon dioxide material designed to be a lightweight “sand”. Ag weighs 0,40 kg/dm<sup>3</sup> vs. Sand at 1,60 kg/dm<sup>3</sup>. It has an irregular surface, which increases surface area over many natural silica products. Ag is intended for removal of suspended solids (turbidity).

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	0,40
<i>Bed depth</i>	<i>(mm):</i>	600 - 900
<i>Service flow</i>	<i>(m/h):</i>	12
<i>Backwash flow</i>	<i>(m/h):</i>	20 - 25

### **Garnet**

Garnet is a high density and small mesh size filter media. Due to its density, it classifies with the media fines on the top, resulting in very fine filtration in the 10-20 micron range. Because of this fine top layer, filtration garnet is seldom used alone as filter runs would be very short. Garnet is used in dual or multi-media filters where larger particles are filtered by larger mesh media.

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	2,25
<i>Bed depth</i>	<i>(mm):</i>	250+
<i>Service flow</i>	<i>(m/h):</i>	25



Seite - 5 -

*Backwash flow* (m/h): 60 - 75

### **Multi-media (multi-layer)**

The practice of layering several different media (usually 3 or 5) results in higher service flow rates and finer filtration down to 10 micron. The media are loaded by density and reverse grading. The most dense media with the smallest mesh size is loaded first and the least dense with the largest mesh size is loaded last with intervening media layered in the same manner. As a result, larger particles are filtered in the first of top layer and

successively smaller particles are adsorbed in succeeding layers. The most common media mix from top to bottom is: anthracite, filter sand, garnet 30x40 (0,4 – 0,6 mm), garnet 8x12 (1,7 – 2,4 mm), gravel 1/8 x 1/16 (1,6 – 3,2 mm), and gravel 1/4 x 1/8 (3,2 – 6,3 mm). While any combination of media can be labeled multi-media, the above section has come to be called multi-media.

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	1,47
<i>Bed depth</i>	<i>(mm):</i>	900
<i>Service flow</i>	<i>(m/h):</i>	25
<i>Backwash flow</i>	<i>(m/h):</i>	35

### **Sand**

Filter sand is naturally occurring, graded and washed sand that's high in silica and low in calcium. It's used for sediment filtration and is often part of a multi-media mix. Sand filters may be the oldest man-made filters and they mimic nature's filtration.

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	1,60
<i>Bed depth</i>	<i>(mm):</i>	450 - 750
<i>Service flow</i>	<i>(m/h):</i>	7 - 12
<i>Backwash flow</i>	<i>(m/h):</i>	35 - 50

### **Granular activated carbon (GAC)**

To manufacture activated carbon, charcoal is crushed to a powder, reconstituted with a binder to the desired mesh size, then treated with high temperature steam. The steam treatment is the activation process, which creates cavities in the charcoal, resulting in a high surface area to volume ratio.

The high surface area gives GAC much greater adsorptive capacity. Charcoal from coal (anthracite), petroleum, animal bones, wood and coconut shells are used to make GAC. Bituminous coal accounts for most of the GAC being used in point-of-use drinking water applications. Acid washing is an optional preparation, which reduces carbon fines and limits pH spikes. Acid or water washing also reduces carbon fines and limits pH spikes. Acid or water washing also reduces any contaminants naturally present in the carbon source. There are several measures of GAC quality including Iodine Number, which is a measure of the amount of iodine adsorbed by weight. Iodine is used as an indicator of

Seite - 6 -

the adsorptive capacity but there's no direct correlation between Iodine and other constituents. GAC is used to reduce organics, volatile organic compounds (VOCs), and taste and odor causing constituents. The best uses of GAC don't include sediment removal. Most suspended solids will fill the cavities in GAC, thus reducing its surface area and adsorptive capacity.

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	<i>0,40</i>
<i>Bed depth</i>	<i>(mm):</i>	<i>600 - 900</i>
<i>Chlorine removal service flow (m/h):</i>		<i>8 - 13</i>
<i>Backwash flow</i>	<i>(m/h):</i>	<i>20 - 25</i>

### **KDF55**

KDF process media are high purity copper-zinc granules (50 percent Cu; 50 percent Zn) that use the redox (the exchange of electrons) to remove chlorine, heavy metals and is bacteriastatic. KDF has an unusually high service flow rate compared to other filter media. KDF cannot be used in aggressive water and is often preceded by some form of neutralization.

<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	<i>2,75</i>
<i>Bed depth</i>	<i>(mm):</i>	<i>250+</i>
<i>Service flow</i>	<i>(m/h):</i>	<i>75</i>
<i>Backwash flow</i>	<i>(m/h):</i>	<i>75</i>

### **KDF85**

KDF process media are high purity copper-zinc (85 percent Cu; 15 percent Zn) granules that use the redox (the exchange of electrons) in products to remove iron, manganese, hydrogen sulfide and is bacteriastatic. KDF has an unusually high service flow rate compared to other filter media. KDF cannot be used in aggressive water and is often preceded by some form of neutralization.

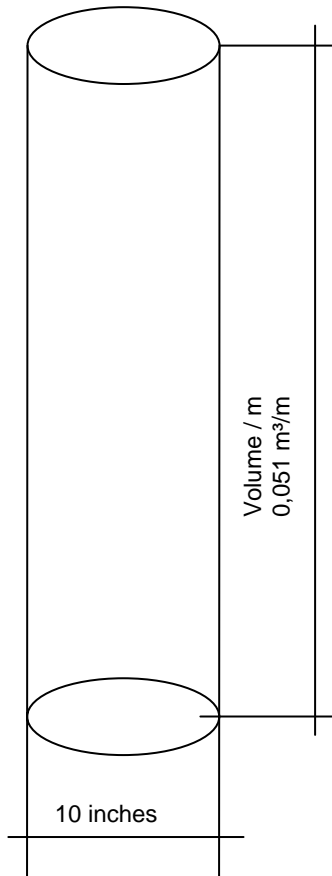
<i>Density</i>	<i>(kg/dm<sup>3</sup>):</i>	<i>2,75</i>
<i>Bed depth</i>	<i>(mm):</i>	<i>250+</i>
<i>Service flow</i>	<i>(m/h):</i>	<i>35</i>
<i>Backwash flow</i>	<i>(m/h):</i>	<i>75</i>

**Figure 2. Sizing Calculations**

In addition to selecting appropriate media for a filter application, sizing cannot be ignored. Obviously, one must size for normal service flow but peak flow and backwashing requirements must also be considered. Most filter media have negligible pressure drop at the recommended service flow rate and can easily handle peak loads up to double the service flow rate without pressure loss concerns. There are exceptions, however, as evidenced by multi-media where double the service flow rate of 2,5 m<sup>3</sup>/h would result in a pressure loss of 1,25 bar.

In some water, chemistry quality suffers with any flow disruption. Peak flows should be limited to the gallons of the empty bed volume (EBV) of the filter. In other words, if you have a 10x54-inch filter tank, the peak flow shouldn't last longer than 18,36 gallons (see Table 2).  
 Backwash rates are often double the service flow rate causing problems if the filter was sized to handle the total available flow from a well pump. If the well pump delivers 2,2 m<sup>3</sup>/h it's sized for such, it will require 4,5 m<sup>3</sup>/h for backwash but the well pump is still limited to 2,2 m<sup>3</sup>/h.

**Table 2. Tank Formula Chart**



**Square Area = ((D)<sup>2</sup> x 3,14 / 4 )**

Example Tanktyp 10 x 54 :  
 D = Diameter in inches  
 H = Height in inches  
 1" = 2,54 mm

$$(10 \times 2,54 / 100) \times (10 \times 2,54 / 100) = 0,0645$$

$$0,0645 \times 3,14 / 4 = 0,0506 \text{ m}^2$$

**Liter Volume per Meter = ((D)<sup>2</sup> x 3,14 / 4 ) x H**

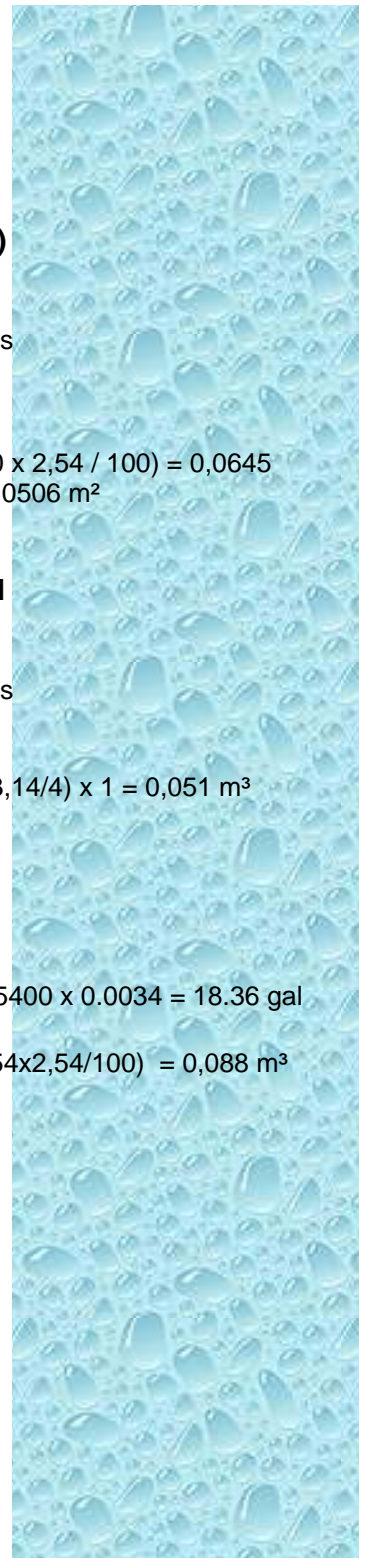
Beispiel Tanktyp 10 x 54 :  
 D = Diameter in inches  
 H = Height = 1,0 m  
 1" = 2,54 mm

$$((10 \times 2,54/100) ^2 \times 3,14/4) \times 1 = 0,051 \text{ m}^3$$

**Tankvolumen = D<sup>2</sup> x H (cm)**

Beispiel Tanktyp 10 x 54  
 10 x 10 = 100 x 54 = 5400 x 0.0034 = 18.36 gal  
 1" = 2,54 mm

$$((10 \times 2,54/100) ^2 \times 54 \times 2,54/100) = 0,088 \text{ m}^3$$



Seite - 8 -

Diameter (inch)	S.A. m <sup>2</sup>	Volume / m m <sup>3</sup> /m	Vol / H Ltr / inch
8	0,032	0,032	0,8
9	0,041	0,041	1,0
10	0,051	0,051	1,2
12	0,073	0,073	1,8
14	0,099	0,099	2,5
16	0,129	0,129	3,3
20	0,203	0,203	5,1
22	0,245	0,245	6,2
24	0,291	0,291	7,4
30	0,456	0,456	11,6
36	0,656	0,656	16,6
42	0,892	0,892	22,7
48	1,166	1,166	29,6
54	1,476	1,476	37,5
60	1,823	1,823	46,3