ANTHRACITE AND MULTI-FILTRATION SYSTEM

Roughly classifying, there are two types in the multi-filtration system as follows:

A) A double filtration system
- A combination of anthracite filter material (upper layer) and filter sand (lower layer)

B) A triple filtration system
A combination of anthracite filter material (upper layer), filter sand (middle layer) and garnet (lower layer)

In the multi-filtration system, it is very imporatant to choose such a filter material of reliable specification as Anthracite. By means of a suitable combination of filter materials, it is possible to restore an agitated filter layer to the initial layer through back-washing, to rapidly filter treatment water, to extend filter run and to improve water quality.

In this system, S. S. are mainly detained on the surface of upper filter layer and grow larger in to floc, while some portion of S. S. is detained on the boundary between filter materials. It is necessary to wash filter material in order to get rid of S. S. and floc.

It is possible to obtain the highest effect when the upper layer of coarse filter material filters comparatively large S. S. and the lower layer of fine filter material filters very small S. S. . This means that filter material of upper layer requires such a large ratio of void as GW. Anthracite can give otherwise the water head loss becomes too large, when the layer still detains a lot of S. S.. The lower layer must be consisted of fine-sized filter material that can check break-through of S. S. Consequently, this combination contributes to reduce a ratio of total water head loss against a total quantity of detained S. S..

The characters of Anthracite is as below:

1. Anthracite is made by crushing the world top quality anthracite lumps imported from abroad and it possesses a high carbon content and an unchangeable quality. It is a hard product which is unflat and rough.

2. Anthracite can be used without anxiety since its effective size and uniformity coefficient are being constantly checked and controled. The product with a low coefficient of uniformity is made for general purpos and its infiltration coefficient is small, compared with other filter materials with a simmilar effective size. Moreover a rate of turbidity is large per unit square. Consequently, filter run can be extended and filtration efficiency is improved.

3. Its specific gravity is close to half of that of sand and its back-washing velocity is less than one third compared with sand. A filter run being far longer than sand, a number of times for back-washing is much less Operation is much economical since a large volume of water for back-wash is saved. Sand is spherical but its coarse surface makes it difficult to set free detained turbid matter. On the contrary Anthracite has many edges and much roughness, but its surface is so smooth like mirror that its back-washing effect can be easily enhanced by separating, detained turbid matters by means of back-washing. Hence no fear of mud balls. It is essential to use Anthracite that is easy for back-washin in case water quality is likely to form highly sticky floc.

4. Fine suspended solids (hereafter called S. S.) are detained through its mutual contacts, because Anthracite's surface area is 20 - 30 % larger than sand due to many edges and much roughness, and also its ratio of void is larger than sand. S. S. contact filter many times over large area, so that S. S. settle and are absorbed in its large area and void called countless sedimentation ponds which are formed in the filter layer of Anthracite. In the case of sand, removal of S. S. is done mainly on surface parts of filter layer. However, since Anthracite functions to remove S. S. form even deep parts, a volume of detained S. becomes extremely large.

5. A ratio of void of sand is about 45 % but that of Anthracite is more . than 55 %. So it takes a longer time till the layer is choked by sludge. An increasing ratio of water head loss is far low, compared with sand, because Anthracite can filter by reaching deep parts of its layer. Extention of filter run is possible until water head loss becomes too big. Initial water head loss is about 20 % less than a same particle size of sand, so filter run is improved.

6. It is possible to accelerate a filtration rate without deteriorating water quality because even coarse grains of Anthracite have larger surface area and big ratio of void, compared with sand. It is easy to make filtration rate of Anthracite 60 % faster than that of sand by gravity filter.
   In case a filtering ability of existing equipment is to be improved, Anthracite accelerates filter run and can greatly ruduce its quantity of washing water. As result, it not only can process much larger water than a filtration by sand but also can improve quality of filtrated water.

7. As all of filtrated water is higher than 6, zeta potential of sand becomes larger on a minus side, but that of Anthracite remains almost unchanged. Consequently, in the case of sand, as pll is higher or ionic value of anion is bigger, infiltration coefficient of floc gets larger. Anthracite can fully detain S. S. in such water.

8. Anthracite possesses nature simmilar to activated carbon because of its high carbonic content. It is so stable in quality that it is etoded by neither acid nor alkali, thereby qualifying it as a most suitable material for filter of solvent. Furthermore, as Anthracite dose not contain silica as sand dose, safety of equipments such as boilers etc. can be assured.

9. Non-Hydrophilic Anthracite has an excellent effectiveness in filtratin; water containing oil. Anthracite is never solidified and its usefullnes: is not spiled as in case of sand. Especially, small grains of Anthracite are most effective in separating oil from water.

10. When fine S. S. are filtered, water head loss becomes never too big or filtraton rate is not reduced by using small grains of Anthracite. In other words, Anthracite can remove fine S. S. that can not be detained by other filter materials.

11. One of big factors in determining a function in rapid filtration is a washing of filter materials. If washing is overlooked, a continuous function of filtration can never be expected and it constitutes a fatal drawback for rapid filtration, causing it impossible to obtain filtrated water of good quality. Above all, a probability of failure is high in the treatment of waste water, unless fully designed by referring to its safety factor.

A) There is a surface washing as one of washing methods for filter materials. Sludge remaining on the surface of upper layer must be destroyed by a stream of surface washing and discharged outside. Unless this process is effectively performed, the sludge that roll in th layer can not be removed outside and filtering function is impaired thereby. Under all circumstances, surface washing is an imperative process in rapid filtration.

B) As to linear velocity of back-washing, collisions of filter materials are most frequent and washing of filter materials is best, when an expansion rate of layer is 30 %. It is therefore necessary to design so that the underdrainage system can distribute washing water evenly in order to obtain the highest effect of back-washing.

C) As regards the air washing apparatus that is being rapidly adopted of late, the best care must be paid in determining an appropriate volum and pressure of air as well as size of bubbles and also in deciding a position to introduce air. And also full precaution should be taken to prevent filter materials from falling down when the supporting gravel is moved by air bubbles. This apparatus can save a large volume of back-washing water.

In the case of the triple filtration system, a process of mixed materials is sometimes adopted. This process is aimed at getting higher effect of filtration by mixing anthracite filter material with filter sand. When this process is employed, it is necessary to take into consideration variations of filter materials in size, uniformity coefficient, thickness of layer and a rate of back-washing expansion. After many kinds of experiments that this proces is one of the best filtration methods and that this can be operated at a linear velocity of about 360 m/d.

A combination of filter materials depends upon a quality of unfiltrated water, a strength of floc, a required quality of filtrated water, filter run and washing velocity.

From the viewpoint of solid-liquid separation, a multi-filtration system is almost perfect. However, this system should be elevated to filter not only S. S. but also colloidal substances and dissolved matters. In order to remove

these matters, a micro-floc system or direct coagulant system must be adopted, whereby phenomenon of coagulation of locculation takes place a these matters are turned into solids for an easy solution.

- Anthracite, which is uneven with a large ratio of void is an outstanding filter material for the multi filtration system.

The below table is about back-washing velocity of Anthracite

Effective size (m/m)	Rate of Expansion (%)	Back-washing Velocity (M/hour)		
		5 ℃	15 ℃	25 ℃
0.4	20	6.6	8.3	10.0
	30	8.4	10.6	12.7
0.55	20	10.7	13.4	16.1
	30	13.6	17.0	20.5
0.65	20	14.8	18.5	22.3
	30	18.8	23.6	28.4
0.7	20	15.8	19.9	23.9
	30	20.2	25.3	30.4
0.8	20	19.6	24.6	29.6
	30	25.0	31.3	37.7
0.9	20	23.5	29.5	35.5
	30	29.9	37.6	45.1
1.1	20	31.7	39.7	47.8
	30	40.3	50.5	60.8
1.5	20	47.8	59.9	72.1
	30	60.8	76.3	91.7

Specification for GW.Anthracite

GW. Anthracite character	Specification
Effective size (GW.— Anth— L)	1.7 ± 0.07 mm
Effective size (GW.— Anth—M)	1.0 ± 0.05 mm
Effective size (GW.— Anth—S)	0.5 ± 0.05 mm
Hardness on the Mohs scale	3 ~ 4
Specific gravity	> 1.45
Uniformity coefficient	≦ 1.7
Acid solubility	≦ 1.0 %
Volatile matter	≦ 6 %
Ash	≦ 5 %
Fixed carbon	≧ 88 %
Bulk density	720 ~ 750 kg/m³
Moisture	≦ 2.5 %

Material Safety Data Sheet

1.Identification of the material and company

Material identity： Anthracite Filter Media
Producer/Supplier：Coodwill Chemical Corporation No.29, Lane 180, Hushan st., Gueishan Shiang, Taoyuan Taiwan, R.O.C.
Phone/Fax：886-3-3296475/886-3-3294977

2.Composition/Information on Ingredients

CAS NO.	**68525-80-4**
H.S. CODE	**2701.11**
Inherent moisture	2%
Ash	7%
Volatile matter	7%
Fixed carbon	85%
Sulpher	0.6%

3.Hazard indication：

The material is classified **NOT DANGEROUS**
* Prolonged inhalation of dust may cause irritation.
* Prolonged ingestion of dust may cause irritation.
* Contact with eyes may cause temporary irritation.
* Contact with the skin may cause temporary irritation.

4.First Aid Measures：

* Inhalation : Remove subject into fresh air and seek medical advice.
* Eyes : Flush eyes with water and remove all particle. Consult a physician if the problem persists.
* Skin : Remove particle and wash.
* Ingestion : Give water and seek medical advice if the problem persists.

5.Fire Fighting Measure：

* Extinguisher Types : Water spray or foam
* Fire Fighting Procedure : Wear self contained breathing apparatus and full protection

6.Accidental Release Measure：

* Personal Precaution : Non-Hazardous * Environmental Precaution : Non-Hazardous * Method for Cleaning Up : Take up mechanically

7.Handling and Storage

* Precautions for Handing : No special instructions * Measures to Protect Against Fire/Explosion : Do not store near a heat source * Storage : Store in a dry place

8.Exposure Controls and Personal Protection

* Respiratory Protection : Not required for normal operation. Recommended for high volume applications if dust is present. * Hand protection : Protective gloves recommended * Body Protection : Overalls and eyes protectionrecommended

9.Physical and Chemical Properties/ Characteristics

Appearance：Granular solid	Color：Black
Odor：None	Fat Solubility：Insoluble
pH value：10% slurry；7.0 ~ 8.0	Boiling Point/ Boiling range：N.A.
Flash point：N.A.	Autoflammability：N.A.
Oxidising properties：N.A.	Relative density：1.4（H_2O＝1）
Water Solubility：Insoluble	Melting Point/range：N.A.

* The material is stable under normal conditions.

10.Stability and Reactivity

* The material is stable under normal conditions.

11.Toxicological Information

* This product is non-toxic.

12.Ecological Information

* Information on Elimination : None * Behavior in Environment : Resistant to bio-degradation * Mobility and bio-accumulative potential : None

13.Disposal Information

* Dispose of to an authorized landfill site. * Please review appropriate national and local waste regulations. * Preparation : The material is not considered to be hazardous.

14.Transport Information

* The product is **Not Dangerous**.

15.Regulation Information

* Labeling : Classified as non-hazardous.

16.Other Information

* The information provided is given in good faith and is based on our actual knowledge.
* This is not a technical sheet for use of the product.
* This sheet does not exempt the user from knowing and applying all the relevant regulations and from taking all the relevant safety precautions.

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