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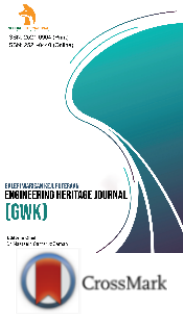

SHORT COMMUNICATION

INDUSTRIAL APPLICATIONS OF FILTER AIDS

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ABSTRACT

Filter aids is a salicaceous inert material for separation of liquid and particulate matters. In general filter aids are obtained from mining where diatomaceous earth and perlite are dominantly used as filter aids for industrial applications. The filter aid has important properties of its rigidness, chemically inertness, insoluble, porous, high permeability, and remove finest particles at high rate. Due to its good stability, less impurities, it is on high demand for separation of high purity products of food, beverages and pharmaceutical industries.

KEYWORDS

Filter aid, Application; Diatomaceous earth, Separation, Filtration

1. INTRODUCTION

Filter aid is an inert material containing solid particles for improved filtration efficiency by a porous, permeable membrane that retains solid particles and control the liquid flow. Filter aid usage has two objectives: 1) for layering and protecting the basic medium called precoat and 2) for flow rate improvement by decreasing the cake compressibility and increasing the cake permeability called admix or body feed (Eagle-Pitcher Minerals, Inc., 1988). Figure 1 showing the mechanism of filtration with and without filter aid of precoat and admix ways.

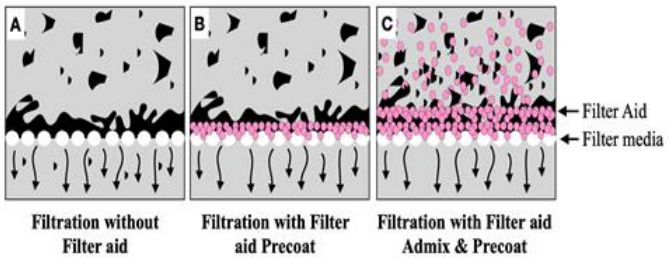

Figure 1: Filtration mechanism with and without filter aid

Filter aids are categorized as diatomaceous earth (DE), perlite, cellulose and others. However, DE and Perlite filters aids are most useful and commonly used for optimum throughput and maximum liquid clarity. DE is the diatomaceous skeleton recovered by mining operation from seabed and further processed to make different grades of filter aid. Filter aid is having different particle size and smaller the particle size responsible for removal of smaller particulate matter but at lower filtration rate (Bächle et al., 2021). Thus, finer grade is for high clarity filtration. Few crystalline type DE are also available but those are doubtful as carcinogen via inhalation route. Perlite is a mineral based but other form of filter aid recovered from natural glossy and volcanic rock which further processed for crushing, heating and explosive expansion to 10 times of its original volume. Both DE and perlite are silica-based minerals and some other filter aid materials are available in are asbestos, cellulose, agricultural fibres, saw dust, rice hull ash, paper fibres etc. Cellulose can be used for filtration system that cannot tolerate silica. However, the filtration efficiency of cellulose is not good as DE or perlite but post filtration process of cellulose may have better cake integrity and it can be incinerated easily. Calcined rice hull ash and fibers from used newspapers are relatively new filter aids used for wastewater sludge dewatering.

2. WHAT IS DIATOMACEOUS EARTH

DE is a massive deposit of diatomite lay asleep beneath the Earth's surface until awakened to play a role as an instrument of modern industry. This deposit is so vast that it has been described by some as inexhaustible. The diatoms are unicellular form of life with cell wall, frustules and the accumulation of fossilized frustules of diatomite and this is the raw material for development of different grades of filter aid where calcination is the important step. The schematic representation of manufacturing of filter aid is shown in Figure 2. The most dominant diatomaceous species found are at Okayama *Stephanodiscus,* Akita *Coscinodiscus,* Oita and China *Cyclotella.* Balaji Enzyme and Chemical Pvt Ltd (BECPL) Mumbai, India is marketing pink and white diatomite deposits of Radiolite® filter aids and its specifications are resented in Table 1.

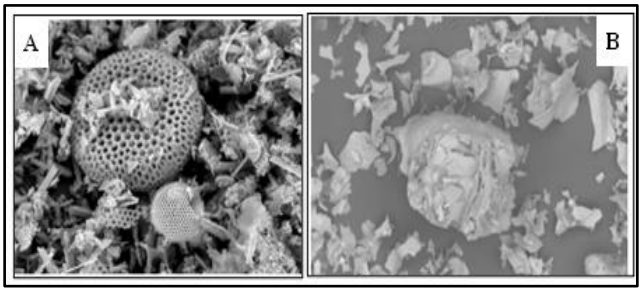

Figure 2: Typical Filter Aids (A-Diatomaceous earth, B-Perlite)

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able 1: BECPL's Filter aids		
Parameters	**RADIOLITE® 200 or 300 (Pink)**	**RADIOLITE® 600 or 900 (White)**
Description	Calcinated dolomite filter aid	Flux calcinated dolomite filter aid
Color	Pink	White
Specific gravity	2.2	2.2
Moisture	<3%	<3%
pH	7	10
Permeability	0.12-0.23 Darcies	1.6-3.5 Darcies
Mesh passing +150 mesh	<5%	<5-10%
Particle size distribution		
>40	16.3-17.1 µ	31.1-34.4 µ
40-20	34.3-34.9 µ	32.7-33.8 µ
20-10	24.2-24.4 µ	18.9-19.7 µ
10-5	14-14.1 µ	7-9.6 µ
5-2	7.7-8.2 µ	3.5-5.7 µ
<2	2-2.8 µ	1.5-2.2 µ
Median particle size	20.3-21.8 µ	27-30.2 µ
Major Chemical analysis		
SiO_2	>92%	>90%
Al_2O_3	4-4.2%	3.2-3.5%

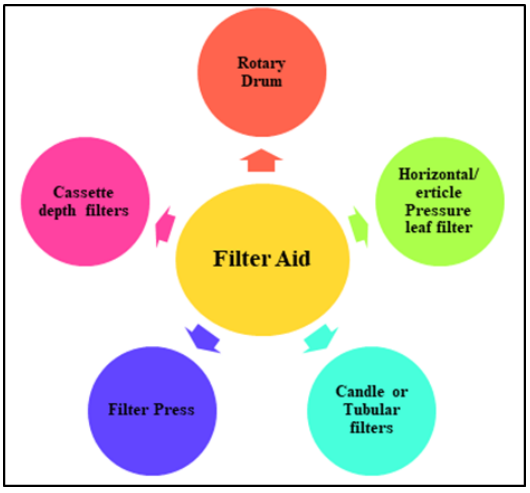

Figure 3: Equipment working compatibility of filter aid

3. Equipment Compatibility

Usage of filter aid in following equipment for liquid clarification for various industrial applications.

The Table 2 showing the sector wise application of silica-based filter aids. Applications of filter aids depends upon the types of filtration process and sometime on end product performance or logical advantages.

4. Fiter Aid Workability

Filtration system consist of filter, filter feed pump, filtration tank containing filter aid for precoating and admixing pump for continuous addition of filter aid. A typical dolomite-based filtration system is schematically drawn in Figure 4. The filter aid can be continuously added as either slurry or by dry feeding. Slurry feeding is generally done with diaphragm pumps or plunger. For batch process, the filter aid can be added directly to the batch as admix. In operation of a filtration system, the filter is first precoated by circulating a mixture of filter aid and clear or filtered liquid from the precoat tank through the filter and circulate back to precoat tank and continued until all the filter aid is deposited on the filter septum. The body feed injection system is then started and filter is changed over, with minimum fluctuations in pressure, from precoating of filtering.

4.1 Precoating

This is the first step of filter aid on the filter septum. The main purpose of precoat is to prevent the clogging of spectum by impurities, to clarity liquid immediately and to facilitate cleaning of spectum at the end of the cycle.

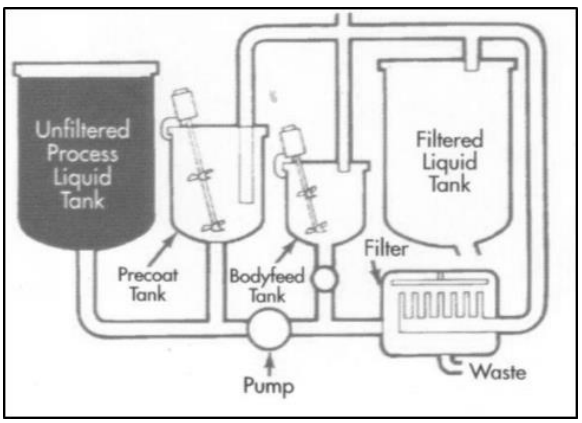

Figure 4: Filter aid-based filtration plant (Silicon Product (P) Ltd.

4.2 Dosing

Generally, 5-10 Kg filter aid/ 100 ft^2 of filter area is used. For poor filtration or new filter, high amount filter aid may be used. For perfect distribution, almost 4.5 Kg filter aid/ 100/ ft^2 of filter area is necessary which form precoat of almost 1.6 mm thickness. Where the precoat slurry

concentration is dependent on the ratio of filter area to the liquid volume of the filter and piping and the precoat pumping rate is depended on the viscosity of liquid. Try to avoid the fast flow rate, as it causes erosion of precoat in the filter. For water, it is 5-7 L/ ft^2 of filter area/ minute, or 40-80 L/m^2 of filter area/ minute. For viscous liquids, the rate will be low 20 L/m^2/hour. So, a general rule for precoating is to precoat at that rate which gives a differential pressure of approximately 2 lbs/ In^2 (13.8 kilopascals).

4.3 Troubleshooting

Precoating filtrate should clear up in 2-5 minutes and continue precoating until the liquid in the filter shell is relatively clear. This process usually takes place in 10-15 minutes. Sometimes the clarity of filtrate could be caused by:

1) precoat erosion by high a circulation rate;

2) blinding of filter septum;

3) insufficient precoat at top of leaves by very little circulation;

4) tears in septum;

5) old screens with worn and/or separated wires;

6) leaks between septum and rum of leaf;

7) worn gaskets between leaf discharge nipple and discharge manifold;

8) wrinkles in septum; and

9) negative pressure on discharge manifold causing flashing inside the leaf.

4.4 Filter Aid Applications

Filter aid has wide applications in food, beverages, drinking water, pharmaceutical, chemical, paint, coating industries as well as environmental sectors. Filter aids are diatomaceous (pink and white) and perlite based but the white types of diatomaceous earth-based filter aid had enormous applications almost in all sectors. Some of the sector wise applications are listed in Table 2.

Table 2: Sector wise application of different filter aids

Application	Sector	RADIOLITE® 200 or 300 (Pink)	RADIOLITE® 600 or 900 (White)	PERLITE
Food & Beverages	Alcohol/ Whiskey	X		
	Beers	X		
	Oils	X	X	
	Vinegar	X	X	
	Honey		X	
	Alginate		X	X
	Sugar/ Starch		X	X
	Sweeteners		X	X
	Wines	X	X	X
	Juices	X	X	X
	Syrups	X	X	X
Drinking water	Drinking water		X	
Pharmaceutical	Enzymes		X	X
	Antibiotics		X	X
	Gelatin	X	X	
	Blood fractionation	X	X	
	Fermentation	X	X	X
Industrial	Biodiesel	X	X	
	Greases			X
	Solvents		X	
	Lube Oil		X	X
	Aluminum cold rolling oil	X	X	
	Aluminum hot rolling oil	X	X	
	Corn gluten		X	
	Gold/ silver mining		X	
	Molasses	X	X	
Chemical	Inorganic chemicals		X	
	Organic chemicals	X	X	X
	Resins		X	
	Polymers		X	X
	Brine		X	
	Adhesives		X	
	Fertilizers		X	
	Amines		X	
	Caustic		X	
	Citric acid		X	
	Dry cleaning solvents		X	
	Liquid sulfur			X
Paint & Coating	Waxes		X	
	Oils		X	
	Varnish		X	
	Gums		X	
	Shellac		X	
Environment	Stormwater		X	X
	Wastewater		X	X
	Swimming pool		X	X
	Media filter drains		X	X

4.5 Merits of Filter Aid

1. Improve permeability and porosity in filter cake
2. Improve filtrate (liquid) clarity
3. Help for contaminant removal
4. Prevent filter medium binding
5. Higher efficiency filtration

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