



**PHOSPHATE FERTILISER PLANT
GAS SCRUBBING TECHNOLOGY**

CROSS-FLOW SCRUBBERS (BLUEFIL®)

**'BECOFLEX' ROTARY BRUSH GAS
SCRUBBER & DE-DUSTING SYSTEM**

PACKED BED SCRUBBERS

'BEGG COUSLAND' Cross-Flow Scrubbers

Begg Cousland can design and supply all types of gas scrubbing equipment, either as 'end-of-pipe' pollution control, or as part of a process.

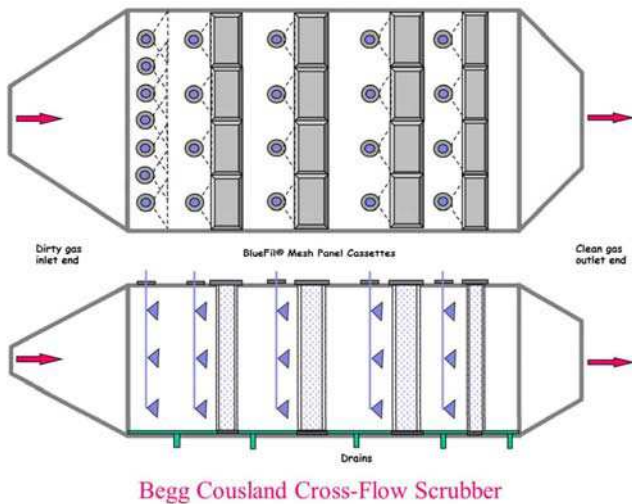
In Phosphate Fertiliser plants (MAP / DAP / NPK) there are many applications for scrubbers to capture solids, aerosols, fumes or gases, most of which have inherent difficulties of blockage and the need for regular maintenance / washing of internals.

For example :

- Fluosilicic Acid H_2SiF_6 Fumes (FSA)
- Reactor Off Gas
- Granulator Emissions

A common technology employed is a Cross-Flow scrubber, where the dirty gas is drawn horizontally through a series of scrubbing and filtration stages. In sequence these stages wet the gas, scrub the gas, and lastly demist the gas, with the option to have a penultimate absorption stage.

The Begg Cousland Cross-Flow Scrubber design is based on BlueFil® meshpad materials made by Benvitec Environment, which are used either as a scrubbing stage packing bed or as a final demister stage.



This system has many beneficial features. For instance :

- The BlueFil® meshes come in a range of materials and styles. Mostly we use PP or ETFE. The meshpads will be composed of a mix of layers of coarse / medium / fine styles (see BlueFil® Mesh Styles table), to suit each application and customer needs.
- The BlueFil® MX095 mesh has the optimum depth and open volume on the market, reducing pressure loss – not efficiency – and meaning it is easier to wash, slower to block, simpler to install and seal than other meshes.
- The drained spray liquids can be re-cycled in a reverse sequence (stage by stage), to minimize final effluent volume.
- The BlueFil® meshpad panels are installed vertically through access doors on the roof of the vessel. This can be done with front and back grid frames or as layers folded over a top rail inside a metal cassette. In either way they are able to be removed and re-fitted easily for washing.



Typical Cross-Flow Scrubber

BlueFil® Pad Style	Efficiency >10μ	Efficiency >5μ	Efficiency >3μ	Efficiency >2μ
MX 99-10	99%	70-85%		
MX99-5	100%	99%	70-90%	
MX99-3	100%	100%	99%	80-85%
MX99-2	100%	100%	100%	99%

The BlueFil® Pad Styles above are combinations of individual layers from the Mesh Types / Specifications below:

BlueFil® Mesh Type	Free Volume %	Thickness (nominal) mm	Surface Area m2/m3
MX 095	96	30	129
MX 094H	96	23	167
MX 094L	93	14	272
MX 040	97	12	314
MX 020	96	5	770
MX 010	95	2	1508

These BlueFil® mesh can replace similar meshes or meshpads with like-for-like specifications or give better efficiency and/or pressure loss and/or blocking resistance.



BlueFil® in a cassette



BlueFil® panel + grids

'BECOFLEX' Rotary Brush Scrubber

A universal, integrated scrubber system to remove solids & liquid particles or to scrub noxious gas emissions.

The 'BECOFLEX' has a wetted fibre brush rotating at high speed in a special volute fan casing, which creates an extremely dynamic gas contact.

Particles in the dirty exhaust gas stream are drawn into the unit by the suction generated by the rotary brush, and they impact at high speed with the spinning brush fibres and become thoroughly wetted. The next effect is for the particles to be centrifugally thrown off, to impact on the wetted inner surface of the volute.

The effluent slurry is then propelled along the exit duct to the disengagement vessel, where it falls to the bottom for removal or recirculation.

The cleaned (wet) gas meanwhile flows upwards in the disengagement vessel to a BlueFil® or 'Becoil' demister to remove any entrained liquid droplets.

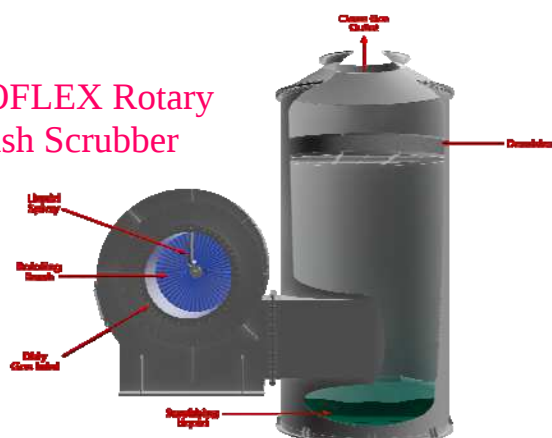
The BECOFLEX system has been successfully used in the Phosphate industry as a stand-alone scrubber package for fugitive fume emission capture from transport wagon loading, discharging or washing. By means of a flexible hose or hood, the Phosphate rock dust and the P2O5 fumes are then drawn into the volute by the suction generated by the rotating brush. The brush is sprayed with water which is recycled from a pump tank.



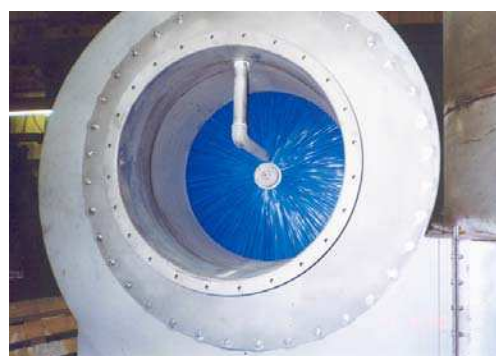
Becoflex BF Unit on a wagon loading duty

BF MODEL	Gas Volume m ³ /hr			Unit Data		
	@ 50mm H ₂ O Fan Static Pressure	@ 80mm H ₂ O Fan Static Pressure	@ 110mm H ₂ O Fan Static Pressure	Approximate Dimensions L x W x H (mm)	Motor Size (Kw)	Brush Spray (Litres / minute) @ 50mm H ₂ O F.S.P. Gas Volume
BF33	1,000	600	200	1100 x 900 x 1350	1.5	5.0
BF40	2,000	1,400	800	1350 x 1000 x 1600	3.0	10.0
BF49	3,000	2,100	1,200	1550 x 1000 x 1750	4.0	15.0
BF57	4,000	3,000	1,900	1750 x 1150 x 2000	5.5	20.0
BF65	5,500	4,000	2,500	2000 x 1250 x 2200	7.5	27.5
BF73	7,000	5,000	3,300	2200 x 1450 x 2400	11.0	35.0
BF81	8,500	6,400	4,200	2400 x 1500 x 2600	11.0	42.5
BF89	10,500	7,800	5,100	2600 x 1550 x 2800	15.0	52.5
BF98	12,000	9,400	6,200	2800 x 1700 x 3000	18.5	60.0
BF114	17,000	12,900	8,700	3300 x 1800 x 3400	22.0	85.0
BF130	25,000	16,800	11,500	3600 x 1950 x 3650	30.0	125.0

BECOFLEX Rotary Brush Scrubber



The BECOFLEX system is compact and acts as its own air mover. This usually means there is no need for a separate fan, but in some cases a secondary or main fan is also used, particularly with long upstream processes.



BECOFLEX BF Units Flow / Suction Options

The Table above shows the Flow rate options for each size of BECOFLEX BF Unit, at 3 different Fan Static Pressure (Suction) values.

For flows larger than 25,000 m³/hr we combine fan volute units in parallel, feeding into a common exit vessel.

BECOFLEX BF Unit Size and Other Data

The Physical Size, Motor Size and Liquid Spray Rate data for each BECOFLEX BF Unit is shown in the table above.

BECOFLEX Rotary Brush Scrubber Materials

The BECOFLEX brush fibres are made of PP or PVDF so there is a 60 or 100°C temperature limit at the inlet.

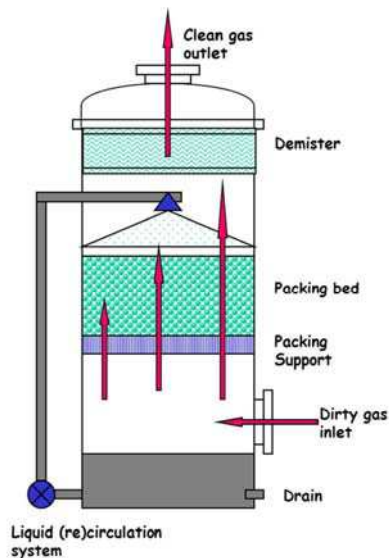
The standard materials for the volute and vessel are Carbon Steel, Stainless Steel, Polypropylene / GRP

'BEGG COUSLAND' Counter-current Packed Bed Fume & Tail Gas Scrubbers

Begg Cousland can design and supply all types of gas scrubbing equipment, either as 'end-of-pipe' pollution control or as a gas cleaning stage within a process.

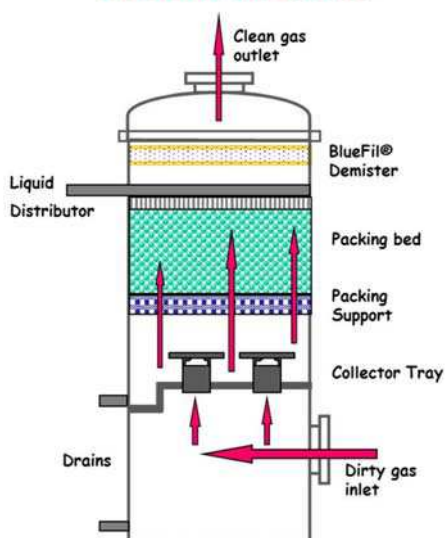
Packed bed scrubbers are designed to give excellent gas / liquid contact and residence time for the reactions, but can be blocked by solid particulates. Where solids are present it is best to use a different design or have a solids removal stage first, for example a Becoflex Rotary Brush Scrubber, to prevent the fouling of the packings.

Conventional Packed Bed Scrubber



In some plants a vertical scrubber design is used, either where the risk of solids blockage is minimal or where space is limited and equipment footprint size is critical.

Packed Bed Granulator Tail Gas Scrubber



Some Fluorine scrubbers are vertical and, like the above image of a Granulator Tail Gas Scrubber, can have a 1st stage random packing bed with liquid distributor counter-current followed by a horizontal BlueFil® Meshpad.



A Granulator Scrubber with random packing only. To have efficiency upgrade with BlueFil® mesh packing.



BlueFil® MX99-10 Pad (not fully assembled)

For further information, please contact us at

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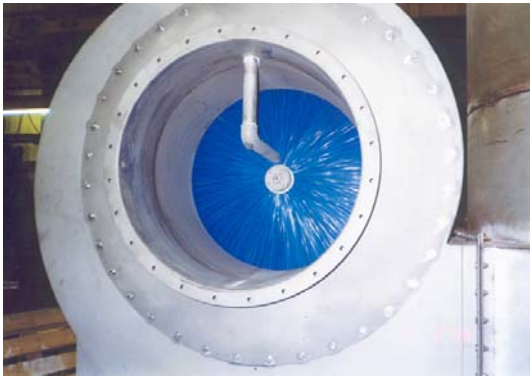
WET CYCLONE SCRUBBERS

CROSS-FLOW SCRUBBERS

DUST & FUME SCRUBBERS

'BECOFLEX' Rotary Brush Scrubber

A universal, integrated scrubber system to remove solids (coarse or fine), to abate liquid particles (aerosols or droplets), or to scrub noxious gas, present in any industrial gas flow.



Technology

The 'BECOFLEX' principle of operation is a wetted fibre brush rotating at high speed in a special volute fan casing, thus creating an extremely dynamic gas contact.

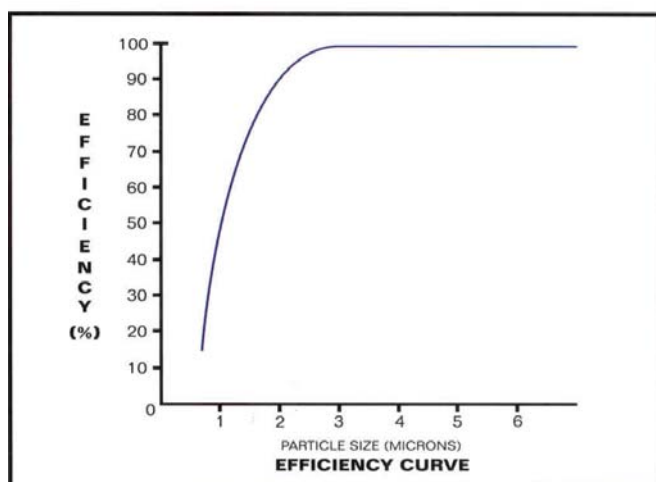
Particles in the dirty exhaust gas stream are drawn into the unit by the suction generated by the rotary brush, and they impact at high speed with the spinning brush fibres and become thoroughly wetted. The next effect is for the particles to be centrifugally washed off, to impact on the wetted inner surface of the volute.

The resulting slurry is then propelled along the bottom of the exit duct to the disengagement vessel, where it falls by gravity to the bottom for removal or recirculation.

The cleaned (wet) gas meanwhile flows upwards from the duct into the disengagement vessel and towards the top gas exit. Usually a 'Becoil' demister is fitted to remove any entrained liquid droplets.

The BECOFLEX system is compact and acts as its own air mover. This usually means there is no need for a separate fan, but in some cases a secondary or main fan is also used, particularly with long upstream processes.

In comparison with the power consumption of a conventional fan, the BECOFLEX will draw up to 60% volume flow for the same power.



Particle Size Efficiency

The BECOFLEX is a **SCRUBBING PROBLEM SOLVER**. The BECOFLEX technology is beautifully simple, which appeals to all engineers - often solving a problem with existing scrubbing systems. Alternative gas scrubbing technologies can have disadvantages, such as :

Packed Towers have random or structured packing, which block relatively easily with any solids in the gas.

Wet Cyclones have medium efficiency only on smaller particle sizes. Also large liquid volumes are required.

Venturis are very efficient, but have high energy requirement, high capital cost and high liquid volume.

However, BECOFLEX's main benefits are :

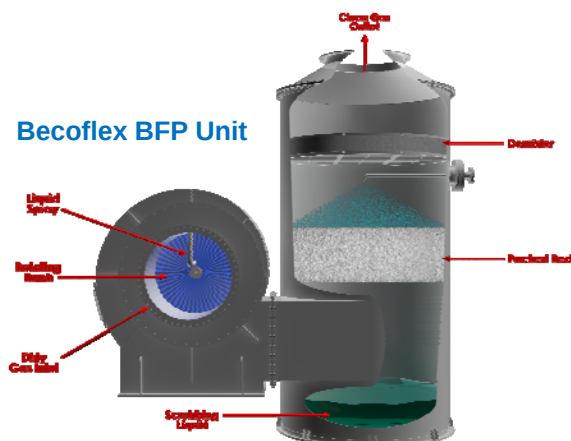
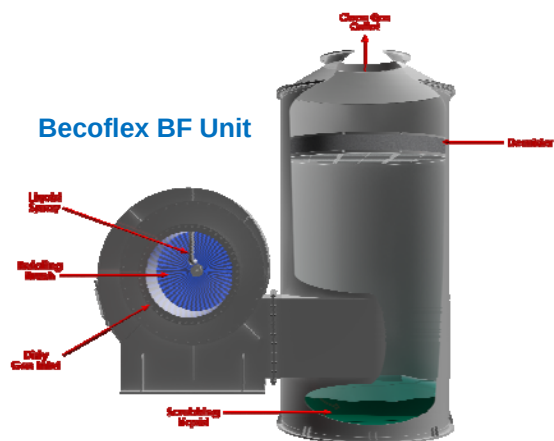
- ✓ It is a self-cleaning wet gas scrubber, where the gas or air impacts on the spinning brush, which is sprayed with low volume liquid. This dynamic action gives excellent gas/liquid contact and means the unit can be very compact.
- ✓ It can handle solids removal with less liquid in & effluent than conventional towers or wet cyclones.
- ✓ It can use water or any chemical solution for gas absorption or odour control.
- ✓ It can be fitted with packings or other 2nd stage equipment for more complex gas absorption duty (the 1st stage brush having removed any solids blockage risk).
- ✓ It acts as its own air moving fan as the brush creates more than just the suction to overcome its own pressure loss, so not only is no separate fan required, it also means it is usually easy to retrofit it to existing process lines.
- ✓ It can act as a solids removal pre-filter in front of, and protecting mist eliminators.



BECOFLEX Rotary Brush Scrubber Materials

The BECOFLEX brush fibres are made of Polypropylene or PVDF so there is a 100°C temperature limit at the inlet. Spray cooling before the volute may be suitable in some cases. A metal brush can be supplied for BF33 and BF40

The standard materials for the volute and vessel are Carbon Steel, Stainless Steel, Polypropylene / GRP



BECOFLEX Design Options

There are 5 main Design options for the BECOFLEX Technology. A Standard design BF, combinations with sprays and different types of contact bed BFA / BFC / BFP, and a combination with mist eliminators BFCF.

BECOFLEX BF Units Flow / Suction Options

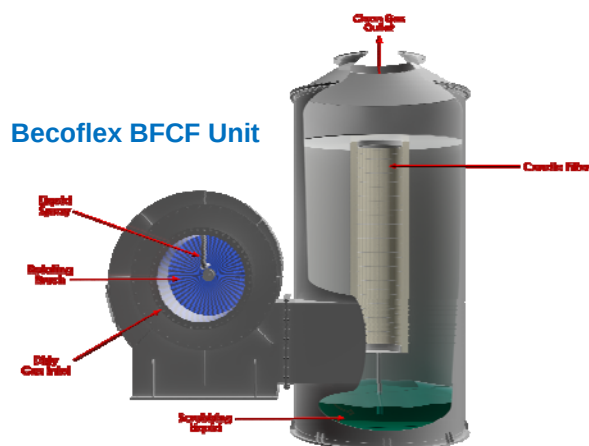
The Table below shows the Flow rate options for each BECOFLEX BF and BFA Unit, at 3 different Fan Static Pressure (Suction) values.

Note 1 : For flows larger than 25,000 m³/hr we combine fan volute units in parallel, feeding into a common exit vessel.

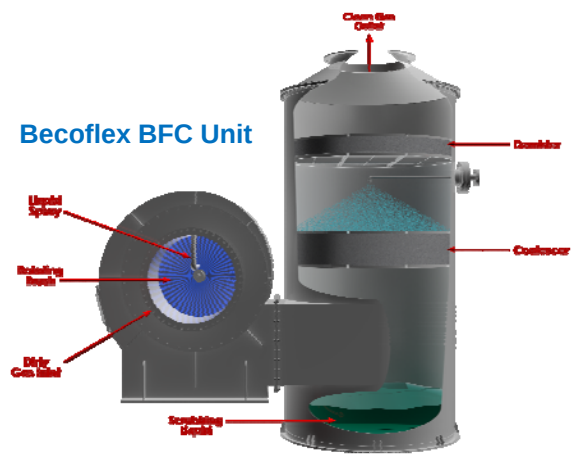
Note 2 : For BFC, BFP and BFCF Units, the Flow rate will be lower than shown in the table, due to the extra resistance caused by the filter / packing.

BECOFLEX BF Unit Size and Other Data

The Physical Size, Motor Size and Liquid Spray Rate data for each BECOFLEX BF Unit is shown in the table below.



BF MODEL	Gas Volume m ³ /hr			Unit Data		
	@ 50mm H ₂ O Fan Static Pressure	@ 80mm H ₂ O Fan Static Pressure	@ 110mm H ₂ O Fan Static Pressure	Approximate Dimensions L x W x H (mm)	Motor Size (Kw)	Brush Spray (Litres / minute) @ 50mm H ₂ O F.S.P. Gas Volume
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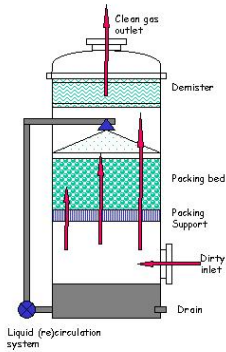


'BEGG COUSLAND' Gas Scrubbers

Begg Cousland can design and supply all types of gas scrubbing equipment, either as 'end-of-pipe' pollution control or as a gas cleaning stage within a process.

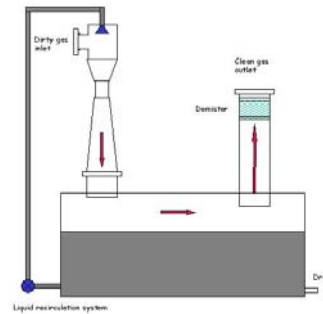
Gas scrubbers are all designed to ensure a good contact and mixing between gas and liquid, usually for Absorption Odour control or Particulate removal. Desorption and Distillation are also mass transfers done in columns. Below are the most common designs we supply.

Option 1. Conventional Packed Bed Scrubber

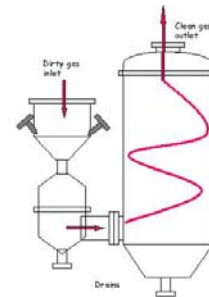


This design removes gas by absorption or by chemical reaction. Suitable for odour control also.

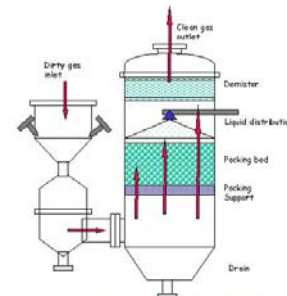
Option 4. Eductor Venturi Scrubber



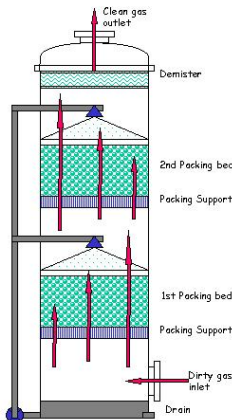
Option 5. Venturi Scrubber + Cyclone



Option 6. Combination Venturi + Packed Bed



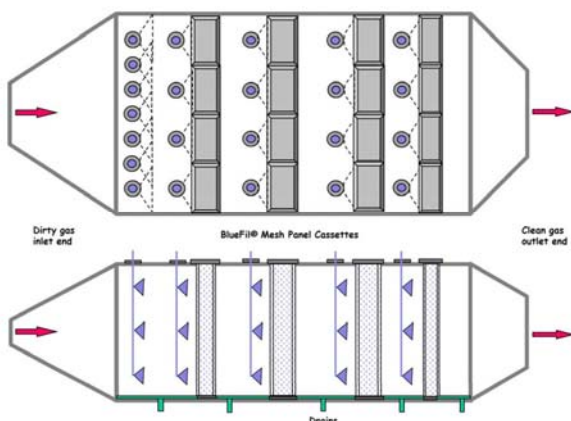
Option 2. 2 Stage Packed Bed Scrubber



This design removes 2 different gases by absorption or by chemical reaction with different liquors with a dividing tray. Suitable for 1st stage 'stripping' and 2nd stage scrubbing.

Packed bed scrubbers are designed to give excellent gas / liquid contact and residence time for the reactions, but can be blocked by solid particulates. Where solids are present it is best to use a different design or have a solids removal stage first, to prevent the fouling of the packings. Begg Cousland offer the BECOFLEX technology for wet removal of solids and cross-flow scrubbers equipped with BLUEFIL® structured mesh packing stages.

Option 3. 4 Stage Cross-Flow Scrubber



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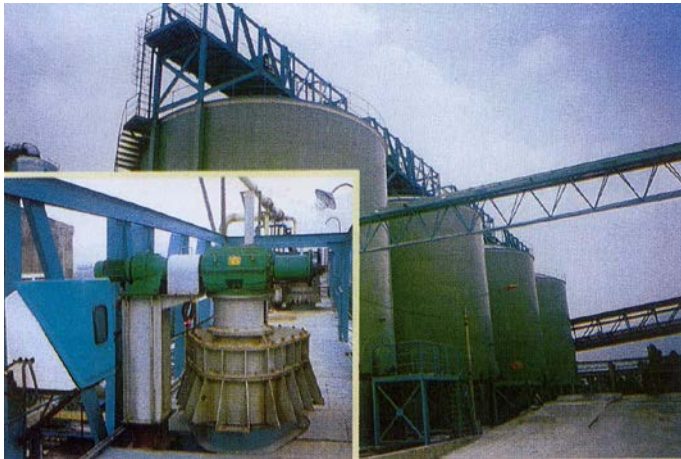


**Reaction Tank Agitator
and Thickener Equipment**

Thickeners

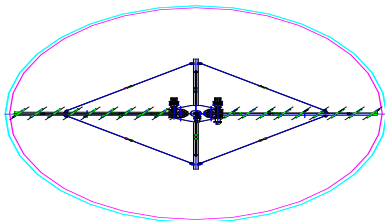
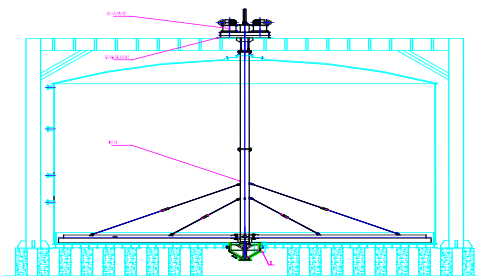
Clarifying tanks make use of gravity to assist separation and sedimentation of liquid / solid mixtures from a blended phase. For example, Clarifying Tanks with thickeners are used in :

- Ore Preparation Plant, separating ore concentrates and washing.
- Slurry sediment tanks in Fine Hydrochloric Plant
- Chlorine Plants separating solution and slurry by sedimentation.
- Sewage Disposal Plant,
- Water Clarification Plant
- Wet Phosphate Processing Factory.



The principle is to separate the liquid and solid by making use of the difference in density between the two phases, generating a relative movement. The lighter phase will flow upward, and solid particles will sediment to the bottom.

Sediment tanks are usually cylindrical and the rotating thickener collects the slurry towards the central bottom outlet. (See sketch below)



Deep Cone Thickeners



As with the Agitator series, each thickener is designed and manufactured according to the needs of each application and its process conditions.

Other Equipment

Begg Cousland also offer the following equipment made in China by the Jiangsu New Hongda Group

- Rotary Table Vacuum Filters
- Vertical Rotary Vacuum Filters
- Vertical Filter Presses
- Tank Rakes

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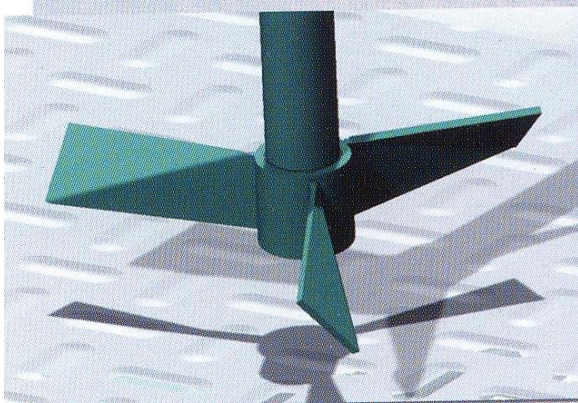
Fax + 44 141 550 1653

E-mail : info@bcenvirotec.com

Streamlined Agitators

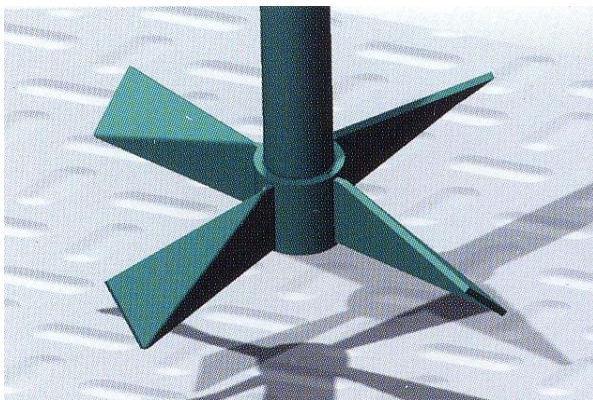
This agitator is primarily designed for phosphorus acid extraction tank, however, it can be used in many applications.

In phosphorus acid reaction tank, the agitator moves the liquid in the same direction as the liquid flow ; The liquid movement of liquid on the surface is small, which can help decrease vapour corrosion and fouling of agitating shaft.



The streamlined agitator has its agitating blades' diameter designed according to the optimum position of the critical area. Although the diameter of this agitator blade is smaller than that of a pitched agitator blade, it has a better effect than the latter.

And as the critical area has small diameter and radial flux, the risk of damage to the wall of the reaction tank will be decreased, which would prolong tank life.



Variable Section – Variable Angle Agitator

The Variable Section - Variable Angle Agitator gives a high axial circulation flow, and low 'cutting' speed at the same time.

Compared with the traditional turbine type agitator with a 45°C folded blade, this improved type of agitator can save energy by 40%~50% , for example in a solid-liquid suspension application, without loss of efficiency.

An application where it has many benefits is in phosphorus acid reaction tanks, and as replacement in some heavy non-ferrous smelting industries, where this type of tank agitator will

- minimise solid material crystallisation
- provide better results for the next filtration and sedimentation stage



Extra-long Agitator in Large Scale Utilized for Phosphorous System

Jiangsu New Hongda made the large-scale mixing equipment for the first 300Kt/a phosphoric acid project in China. To do this they developed a new range of agitating equipment of high power, heavy load and with an extra-long shaft.

In addition to using traditional materials such as plates and pipes in 304L, 316L, 317L and 904L, more than ten new materials were successfully developed.

We can therefore offer excellent / optimum anti-corrosion & wear characteristics of the agitator in many different alkali & acid liquid conditions .



Typical Applications :

- Non-Ferrous Ore Oxidising Tank
- Phosphoric Acid plant Digestion Tank
- Phosphoric Acid plant Reaction Tank
- Phosphoric Acid plant Slurry Tank



Introduction

Begg Cousland and the Jiangsu New Hongda Group began their collaboration in 2002, when a license agreement was signed between the 2 companies. Since then the Begg Cousland mist eliminator range has been assembled and marketed in China by Jiangsu New Hongda, with huge success.

In 2006 Begg Cousland started to market the Jiangsu New Hongda process equipment range to the Phosphate / Process industries outside China, under an exclusive agreement.

Begg Cousland has now supplied many such agitators, and the customer reaction is 100% positive in terms of the quality and performance, and of course for the extremely attractive price.



Agitator Design

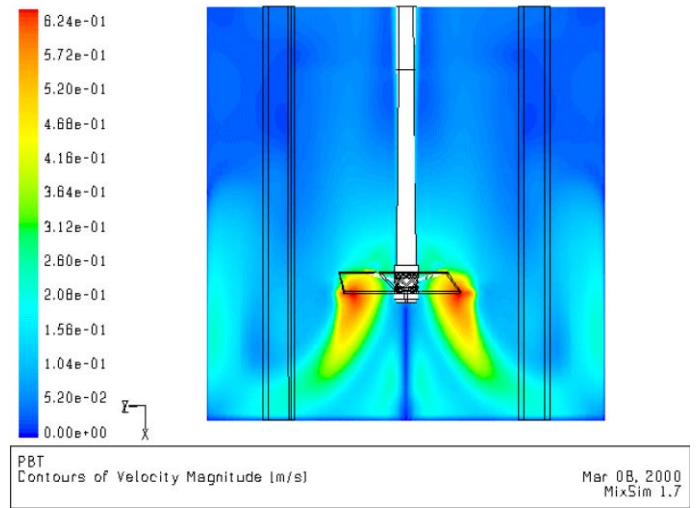
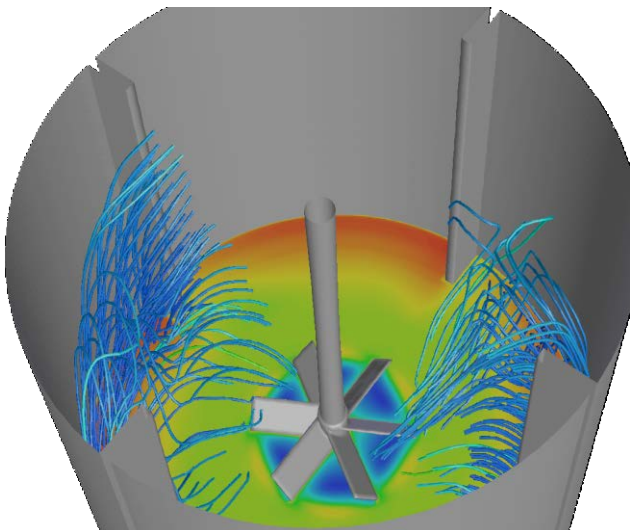
Design and selection of the agitator type depends completely on the process duty. Different agitating processes need to be done by different agitating equipment.

Initially, design focuses on agitator type, motor power and rotating speed.

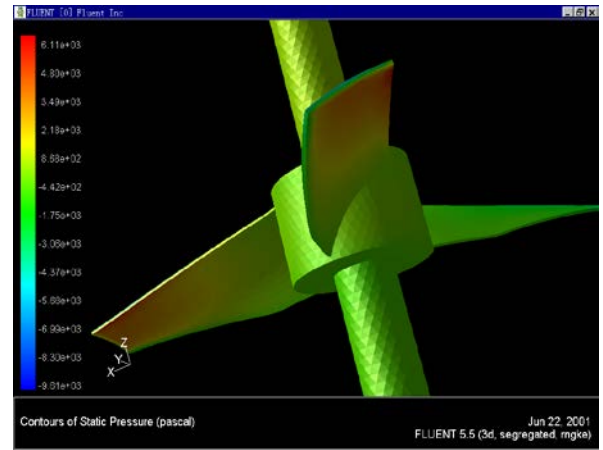
Next we select components such as speed reducer, brackets, agitating shaft and bearing sealing, etc.

- The agitator type is selected according to general process duty requirements.

If in doubt, our own CFD software for agitator simulation is used to aid selection.



- Motor power, rotating speed and agitator diameter are calculated by computer simulating design software. In cases of unusual mixtures, this can be done by testing in our test tanks to prove the agitating mixture time, the sedimentation speed and the degree of dispersion.



- The reducer is selected according to motor power, rotating speed, torque etc.



- The Design of the agitating shaft and it's construction involves careful calculation of rigidity.
- A speciality of ours is the design of large agitators with extra-slim and long flexible shaft.
- Generally we suggest agitator designs without any supporting structure inside the tank, to minimise the risk of abrasion, vibration and excessive energy consumption.