ARMATEC Handbook

Fibreglass Ventilation Systems

Ducts .. Covers .. Fans .. Scrubbers

ARMATEC Environmental Ltd

The environment is our business

Our chemical engineers experienced with fibreglass and industrial projects:
Ken Holyoake (Managing Director), Maarten Bangma (Director), Todd Landers (Design & Sales Engineer), and Dominic Goldsbrough (Projects Manager).

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Welcome

Third Edition: August, 2010

This publication brings together technical details and information on components of ventilation systems; namely ducts, hoods, covers, fans and scrubbers. We hope this information gives you confidence to specify fibreglass for your next project.

All fibreglass construction has many advantages:

- *corrosion resistant inside and outside for long life in corrosive environments*
- *light weight for easy handling and installation*
- *flexible design ... all shapes and sizes possible*

Fibreglass ventilation systems are our speciality. ARMATEC has been designing, manufacturing and installing ventilation systems for more than 25 years. We are proud that we are using our chemical engineering expertise to improve the environment, and look foward to helping you with your projects.

Ken Holyoake
Managing Director of ARMATEC Environmental Ltd
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PS: Please take advantage of the resources on our web site, including technical bulletins, engineering information, and project summaries. See below.

www.armatec.co.nz

"Products" For technical bulletins

Our home page. Click on the subheadings, e.g. "Fibreglass Products" to go to pages that include technical bulletins on fibreglass ducts, covers and hoods, fans, scrubbers, etc. Alternatively use the product menu down the left hand side of any web page to go directly to information on that product. Easy and fast to use.

"Free Information" A valuable resource

Information and technical papers on fibreglass, engineering and our company are a valuable resource for you to refer to, with most articles initiated in response to customer questions. For example there is an article on "Handling Fibreglass Vessels" that is useful for your people and transport operators to minimise any damage. Armatec is happy to add articles on a subject of your choice.

"Projects"

Information on significant projects undertaken by ARMATEC, including pdf files and photos. ARMATEC is happy to supply additional information on any of these projects on request.

Product Summary

FRP (fibre reinforced polyester, or fibreglass) products with proven performance in handling the range of chemicals and temperatures found in industrial ventilation systems, e.g. pulp & paper mills, fertiliser plants, rendering plants, chemical plants and wastewater treatment plants. All products are manufactured by the contact moulded method to achieve maximum corrosion resistance; and are made to international standards. Armatec is ISO 9001 accredited.

	STANDARD SIZES	OPTIONS
Ducts & Fittings	100, 150, 200, 225, 250, 300, 350, 400, 450, 500, 610, 760, 818, 910, 1070, 1200, 1500, 1800, 2000 diam plus Elbows, tees, wyes, flanges, dampers	For buried ducts, stiffness options incl: SN1250, SN2500, SN5000, SN10,000
Covers & Hoods	Custom designed to suit Barrel vaulted design Flat designs for lowest profile	Access hatches Duct connections
Fans	Centrifugal and axial fans Range of impellor styles Range of discharge options Belt driven or direct drive	Noise attenuation Support springs
Scrubbers	Packed bed scrubbers Venturi scrubbers Void tower scrubbers Cyclones & mist eliminators Biological scrubbers Carbon beds adsorbers	Integral with manhole Access ladders Level control instr.
Stacks	Free standing and guyed designs Venturi diffusers for greater dilution	Access ladders
Site Installation	Full installation service Butt and strap jointing Balancing of airflows Performance testing	Full installation service Materials only supply
Training	Butt and strap jointing	In factory or on site

All available from one source

For pricing information contact ARMATEC. Detailed bulletins for most products are available on the website at www.armatec.co.nz. Lead times are typically 4 to 6 weeks after drawings are "Approved for Construction" by yourselves.

Fibreglass Ducting

... Technical Informaion

A complete range of ducting, bends, tees, flanges, reducers, dampers and other accessories is available, all fabricated in 100% corrosion resistant fibreglass that is also weather and sun resistant on the outside. The light weight properties of fibreglass make handling and installation easy. The versatility of fibreglass enables the construction of complex ducting networks to reliably and economically handle corrosive gases.

Construction Standards

Fibreglass ducting is constructed by the contact moulded method for maximum chemical resistance. The exterior finish is a pigmented resin coat with off-white being the most popular colour. All ducting is fabricated to international fibreglass standards such as AS 2634. ARMATEC is ISO 9001 accredited with BVQI as the supervising auditors, thus assuring clients of consistent high quality products. Full replacement warranties are provided.

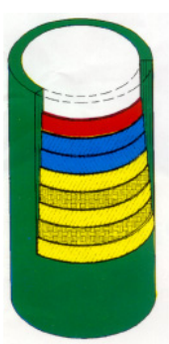
Resin Selection

Resin selection for each project is determined by the chemical environment and operating conditions, including temperature. Standard resin systems include isophthalic, vinyl ester, and chlorinated polyester (see page 26). Other special resins available include fire retardant options. For detailed information contact ARMATEC.

Typical Physical Properties of ARMATEC FRP Duct

General		**Typical physical properties of 10mm thick laminate**		
Specific Gravity	1.5			
Linear Coefficient of Thermal Expansion			MPa	psi
(ASTM D696) .. 27 x 10^{-6} (m/m -degC)		Ultimate tensile strength(ASTM D638)	103	15,000
Thermal Conductivity	1.5 W/mK	Flexural Strength (ASTM D790)	152	22,000
Glass Content	30 -35 %	Flexural modulus of elasticity(ASTM D790)	6,895	1,000,000
Barcol Hardness	35 to 45	Compressive strength (ASTM D695)	152	22,000

Specific physical properties are dependant on wall thickness, laminate construction and resin selection. Contact ARMATEC for detailed information and advice. Note: Numbers given are typical properties, not to be construed as a specification.



Cross Section of Fibreglass Duct

Inner Surface. The interior surface 0.25mm - 0.5mm, is a smooth resin rich laminate reinforced with surface veil. Providing optimum corrosion-resistance and a minimal friction factor when combined with the best resin for the specific chemical conditions.

Next Interior Layer. Duct in all diameters is built with an additional chemical resistant liner at least 2.5mm in thickness in the form of chopped strand mat which critically limits chemical permeation.

Remaining Thickness. Subsequent reinforcing layers of woven roving and chopped strand mat are used to build the duct to the desired wall thickness.

Exterior Surface. The final layer provides protection against weathering, fumes, spillage and ultraviolet attack. This gives the duct a longer life and reduces maintenance expenses.

Fibreglass Ducting

... Duct Sizing & Jointing

Standard sizes available are from 100 mm to over 2400 mm in diameter. Standard duct lengths are 6 metres. Elbows are swept style up to 760mm diameter, and mitred for larger diameters.

Duct Sizing - Branched Design

The typical gas velocity selected for branched design ducting networks is 11 to 13 cu.m./sec. This velocity range usually gives the optimum balance between pressure drop losses and cost of the duct. For gases with solids, higher velocities of 20 to 23 cu.m./sec are often used to minimise the solid particles depositing out. ARMATEC offers full duct network analysis services to check duct size selections and the resulting pressure drops.

Duct Sizing - Plenum Design

Projects with a number of small ducts off one main line require special plenum design. A larger main duct has an increased diameter to slow the gas velocity and balance the pressure drops, to enable each branch to have the same extraction rate.

Plenum style header and branches

Duct Jointing

Standard butt and strap jointing is the most common and preferred method - see page 29 for description. Socket style jointing options are also available, and this method can speed installation.

Duct Sizing Table

Duct Diam	Duct Area	Gas Volumetric Rate at Velocity Stated, cu.m./sec				
mm	sq.m.	11 m/s	13 m/s	15 m/s	20 m/s	23 m/s
153	0.02	0.20	0.24	0.28	0.37	0.42
206	0.03	0.37	0.43	0.50	0.67	0.77
257	0.05	0.57	0.67	0.78	1.04	1.19
305	0.07	0.80	0.95	1.10	1.46	1.68
413	0.13	1.47	1.74	2.01	2.68	3.08
517	0.21	2.31	2.73	3.15	4.20	4.83
618	0.30	3.30	3.90	4.50	6.00	6.90
766	0.46	5.07	5.99	6.91	9.21	10.59
919	0.66	7.29	8.62	9.94	13.26	15.25
1072	0.90	9.92	11.73	13.53	18.04	20.75
1202	1.13	12.48	14.74	17.01	22.68	26.09
1480	1.72	18.91	22.35	25.79	34.39	39.55

Notes: Other duct sizes are available. Please consult ARMATEC.

Fibreglass Ducting

... Duct Wall Thicknesses & Supports

Duct Wall Thicknesses

For detailed design of ducting, specific factors to consider are:

- Chemicals and temperatures to be handled
- Duct pressure, often partial vacuum
- Expansion and contraction
- Wind and seismic loads
- Other loads such as dampers and equipment
- Personnel and other loads e.g. during clean out
- Loads from any solids deposition
- Positions that hangers and supports can be placed.

Minimum duct wall thicknesses from AS 2634 are given below.

Duct Hanger and Support Design

In general ducts up to 600mm in diameter, and not subject to vacuum service, should be placed on saddles or in hangers providing 120 degrees minimum bottom support and full bearing over the supported area. For ducts of 600mm nominal diameter and above, 180 degrees bottom support should be provided. Any clamps or "U" bolts used in conjunction with the bottom supporting structure should provide a snug fit and not exert clamp pressure. Duct supports should have a minimum width of 50mm. Ducting should be supported and anchored to prevent undue loads on the duct itself and on connected equipment, and to permit controlled thermal expansion and contracton between fixed points and changes in direction. Larger spans require increased duct wall thicknesses.

Table: Minimum duct wall thicknesses and maximum hanger/support spacings for these wall thicknesses

Nominal Duct Size, mm	Min. Duct Wall, thickness, mm	Max Hanger/Support Spacing, mm
100	3	3000
150	3	3500
200	3	3500
250	3	4500
300	3	4500
450	3	4500
500	3	4500
600	5	4500
750	5	4500
900	5	6000
1000	6	6000
1200	6	6000
1500	6	6000

Fibreglass Ducting

... Dampers for Airflow Control

Standard dampers are used to control airflow rates within the branches of a duct network. Usually these dampers are non-sealing to minimise pressure drop losses, and manually operated to fine tune the gas flows throughout the duct network. It is important to site the dampers at strategic points so that this control of the system can be asserted. Sample points are usually installed close by to allow pitot tube entry for flow measurement.

Dampers are also used to isolate specific lines, for example when a duty and standby fan are used. In this case the dampers have a sealing seat to minimise gas leakage. The operation can be either manual or with actuators operated remotely.

All parts of the dampers in contact with the air stream are made of fibreglass, including the shaft and blade. Manual dampers have a fibreglass quadrant, handle, and stainless steel wing nut on the outside to provide adjustment and locking in position. The actuators can be either air operated or electrically operated depending on site requirements.

Manual and actuated fibreglass dampers with quadrant handle.

Fibreglass Covers & Hoods

Covers and hoods are the first important step in any air pollution control project, as they contain and capture gases preventing the release of odours and noxious gases to atmosphere. Best industry practice designs are used.

Features of Fibreglass for Covers & Hoods

- **Light weight** fibreglass allows easy transport, assembly, and lifting into position. Plus it makes them easy to move to access equipment beneath.
- **Corrosion resistant** fibreglass is ideal for use with corrosive gases, and where the external chemical plant atmosphere is corrosive. The fibreglass resin and reinforcements are chosen to suit the specific chemical environment.
- **Low maintenance** ... minimal ongoing costs and long life.
- **Design flexibility.** Almost any design is possible.
- **Ease of modification post installation.** The versaility of fibreglass allows extensions or adjustments to be done at any time throughout a project as process requirements change.

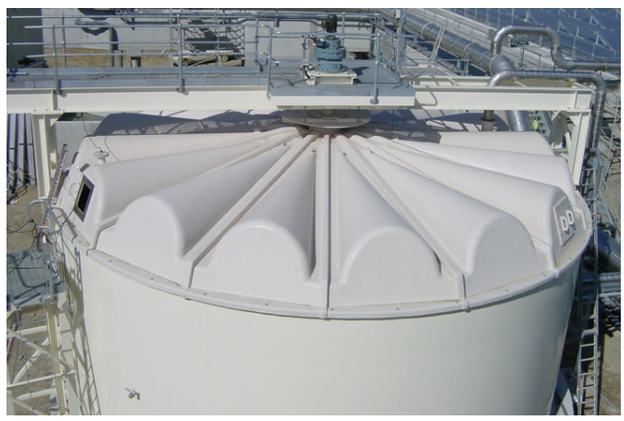



Top left and right: Removeable segmented covers over inlet chambers and PST tanks at wastewater treatment plant. Bottom left: Removeable cover over tank at wastewater treatment plant. Bottom right: Covers over pulp washers at pulp and paper mill.

Fibreglass Covers & Hoods

Typical Design Features

- **Sectional Design:** Multiple sections provide for easy site assembly, and later removal to access equipment for servicing.
- **Stiffeners:** Ribs are used to provide stiffness to the overall cover so that it can withstand wind loads and the weight of personnel standing on it.
- **Total Enclosure:** Can be designed to achieve total enclosure when there is no air extraction provided.
- **Openings Design:** When equipment is vented to an air pollution control system, hoods are designed to provide an air velocity of 0.5 to 1.0 metres per second through any openings. This ensures odorous and noxious gases are contained and captured.
- **Site Specific Designs:** Covers are designed after taking into account process requirements for access to the equipment. This may include removable panels, or plastic strip curtains or other solutions. We work with the plant engineers and operators to develop an agreed design.
- **Lip Extraction Hoods:** These are used for extracting gases from tanks which cannot be covered over, e.g. when overhead cranes are used to load and unload the tank.
- **Air Curtains:** These are used to minimise gases escaping from larger openings.
- **Externally Coloured:** Fibreglass is easily coloured with a permanent external colour coat for plant identification or safety purposes.
- **Stainless Steel Options:** Covers can be made in stainless steel, e.g. for special food processing applications.



Segmented barrel vault design fibreglass cover for a WWTP thickener at Lower Hutt, NZ.

Segmented barrel vault cover over fermenter tank, Ballarat, Australia.

Flat segmented cover over clarifier tank, Sunset Coast, Australia.

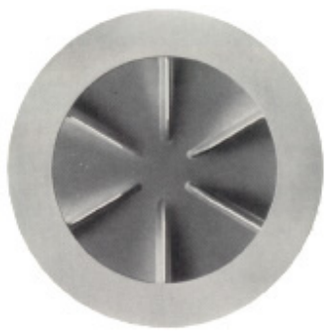
Fibreglass Fans

... Range Overview

A full range of high quality, low noise, low maintenance and corrosion resistant centrifugal and axial fibreglass fans, manufactured by ARMATEC in New Zealand under licence to Ceilcote Air Pollution Control of the USA, includes:

High Efficiency CLUB Fans: CLUB fans have special backward curved blades giving high efficiencies of 70% to 80% (below left). This means reduced running costs compared to alternative fans. Pressure to 350mm WC (water column). Flows from 0.3 m^3/s to 34m^3/s.
High Pressure CH & CHP Fans: CH/CHP fans are for pressures to 760mm WC (below centre). These are used with venturi scrubbers or in other high pressure drop systems. Flows from 0.02m^3/s to 24m^3/s.
Self Cleaning CMHP Fans: CMHP fans have standard "paddle wheel" radial bladed impellors (below right). These impellors are self cleaning to a high degree and have a long history of successful operation. Pressures to 400mm WC. Flows from 0.1m^3/s to 42m^3/s.



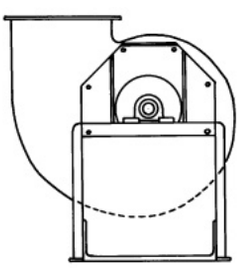
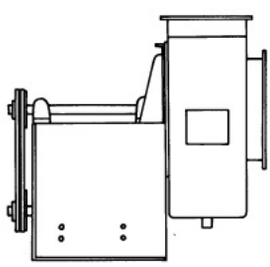
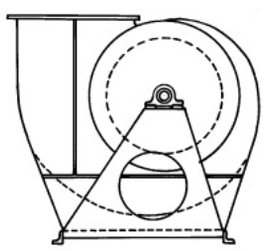
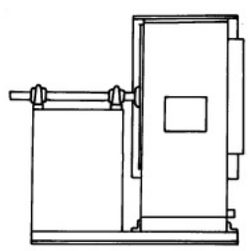


Arrangement Options

For belt driven fans, standard arrangements are:

- Arrangement 10 for smaller fan sizes (below left).
- Arrangement 9 for larger fans (below right).

For direct drive fan, the motor is mounted directly on the base.

Discharge Versatility

Fans are available in clockwise or counter-clockwise rotation. The discharge position can be either of 8 positions such as top horizontal, top angular down, downblast, bottom angular down, top angular up, upblast, bottom angular up and bottom horizontal. This allows maximum versatility in selecting the fan for your site. Fan inlet and outlet ducts can be plain or flanged.

Fibreglass Fans

... Features

Certified Performance Data

Full performance data is available for all fans, obtained from tests conducted by Ceilcote Air Pollution Control of the USA in accordance with standards published by the AMCA (Air Movement and Control Association Inc of USA), and are thus licenced to bear the AMCA seal. Ratings are based on tests made in accordance with AMCA Standard 211 and comply with the requirements of the AMCA Ratings Programme.

Better Design

Ceilcote Air Pollution Control of the USA has led the development of fibreglass fans in the USA. Their designs are based on more than 30 years of experience building thousands of fibreglass fans.

Zero Fan Blade Failure

ARMATEC has zero incidence of fan blades detaching from operational fans. The first ARMATEC fan was manufactured in New Zealand in 1983 and since then over 50 units have been supplied. The zero incidence of fan blades detaching is due to proven design, superior knowledge of the limitations of impellors, and to the highest quality of construction.

Dynamically Balanced

All impellors are dynamically balanced using certified balancing equipment.

Belt Driven as Standard

Belt driven allows for the air flow rate and/or differential pressure to be varied simply by changing pulleys and belts. Vee belt drives and belt guards are standard. Direct drive designs are available on request.

Fans Test Run Before Dispatch

Fans are test run before dispatch to ensure proper assembly, alignment and balancing. The exact operational speed of the impellor is checked.

Fibreglass fans handling air with hydrogen sulphide at wastewater treatment plant on the coast.

Fibreglass Fans

... Noise

ARMATEC Fibreglass Fans have low noise characteristics when compared with equivalent metal fans; the fibreglass fan housing absorbs noise, internal surfaces are smooth and fan speeds are typically lower. The high efficiency range of CLUB fans are very low noise. Further acoustic insulation and silencers are available on request to meet low noise specifications.

Fan Noise

The total sound power level, LwA, at 1 metre from the fan is the greater of the adjusted noise from the fan itself, and from the motor. Fan noise is generated by the turbulence within the fan housing and varies by fan type, impeller design, flow rate, pressure and fan efficiency. Part of the energy not put into moving the air ends up as noise, so more efficient fans generate less noise. Fan noise predictions at a site start with the power sound levels at the specific duty point, and are adjusted by calculation for the specifics of the installation, such as: ducting configuration, reflecting surfaces in area of installation, and noise attenuation systems used.

Weighted Sound Power Level

The sound power level is the acoustic power radiating from the source, i.e. the fan. The weighted sound power level (LwA) given is the logarithmic summation of the sound power values of the 8 octane bands of the audible frequency spectrum adjusted to represent the effect of the “A” weighted network. A typical figure would be an LwA of 90 dBA, and this figure is the total sound power generated by the fan at 1 metre.

Adjustments to Sound Power Levels

Inlet and outlet ducting can reduce the fan sound power at source by 20 to 35 dBA by containing the noise in the duct. Flexible duct connectors and vibration isolators absorb energy, and so avoid the energy being released as noise. Noise attenuation material can be incorporated into the fan casing to reduce noise breakout through the casing, and can reduce sound power levels in the order of 15 dBA. Low noise motors are an option to reduce motor noise contribution. For the 90 dBA fan above, typical ajustments for a ducted fan with vibration isolation devices fitted, would be 25 dBA, reducing the fan sound power level at 1 metre to 65 dBA. The noise contribution from the motor must be allowed for at this stage.

Sound Power Level at a Distance from Installed Fan

The sound power level at a specific distance from an installed fan can be calculated from a standard formula; consult ARMATEC or your noise consultant. The calculation includes a factor Q, the Directivity Factor, and depends on the location of the nearest walls and other noise reflecting surfaces. At a distance of 10 metres, the drop in the power sound level is typically 15 dBA. For the 90 dBA fan above, and when ducted becomes 65 dBA, the power sound level at a distance of 10 metres will be about 50 dBA.

Acoustic enclosure over fan

Fibreglass Fans

... Life Cycle Cost Analysis

Choosing Between Fan Options

A number of different fan options are usually available for any specific air flow and pressure drop. Life cycle cost analysis is a useful tool for comparing different options; the lowest initial cost option is not necessarily the most economical long term.

Fan Size & Efficiency

The lowest initial cost fan is usually the smallest fan. The most efficient fan has the lowest operating cost, and is often a larger fan. Councils have advised ARMATEC that running costs are more important than capital costs, and have more impact on Council rates.

Fan Life Cycle Cost Analysis: An Example

Inital Costs

For an air flow of 9,630 cu.m./hr at a pressure drop of 1400 Pa, the fan options are:

Model	Impellor Style	Duct Diam	Shaft kW	Eff %	Drive Type	Unducted Noise: dBA	Initial Cost	Bearing Set Cost	Belt Set Cost
CMHR 16	Forward	400	6.2	61	Direct	85	$24,500	$250	NA
CMHR 18	Forward	450	5.6	67	Belt	84	$27,400	$300	$170
CMHR 20	Forward	500	5.3	71	Belt	84	$31,200	$350	$190
CLUB 2225	Backward	500	5.8	65	Belt	92	$33,900	$400	$210
CLUB 2550	Backward	610	5.9	64	Direct	91	$41,400	$450	NA

The lowest initial cost is the CMHR 16 fan, the smallest fan. The initial cost of the most efficient fan, the CMHR 20, is 27% higher than the lowest cost fan. In this example, the high pressure drop of 1400 Pa is at the top end performance of the usually more efficient backward curved CLUB fans.

Total Costs

Assuming 8400 hours operating per year, and a power cost of $0.18 c/kWhr, belt and bearing changes every 2 years, and no financing charges, total costs are as follows:

Model	Year 1	Year 2	Year 4	Year 6	Year 8	Year 10	Year 15	Year 20
CMHR 16	$34,907	$45,188	$65,751	$86,315	$106,878	$127,441	$178,849	$230,257
CMHR 18	$37,463	$47,291	$66,947	$86,603	$106,259	$125,915	$175,055	$224,195
CMHR 20	$40,693	$49,916	$68,363	$86,809	$105,256	$123,702	$169,818	$215,934
CLUB 2225	$44,335	$54,466	$74,727	$94,987	$115,248	$135,509	$186,161	$236,813
CLUB 2550	$51,453	$61,281	$80,937	$100,593	$120,249	$139,905	$189,045	$238,185

Lowest Life Cycle Cost

The CMHR 20 fan has the lowest LCC over 20 years. It becomes the lowest LCC option at year 7.

Ask ARMATEC to provide you with this analysis, or compile it yourself with other fan options you are considering. In corrosive duty, non-fibreglass fans may need replacing, for example every 5 years, and this additional cost must be included in any LCC analysis.

Scrubbers

... Packed Bed Scrubbers

Packed bed scrubbers are used for high efficiency removal of pollutant gases from airstreams. The basic process involved in wet scrubbing is the contacting of a polluted gas stream with a scrubbing liquid to transfer sufficient of the pollutants into the liquid stream to allow discharge to atmosphere of the cleaned gas. Transfer mechanisms include absorption, chemical reaction, condensation, and inertial impaction. Packed bed scrubbers are manufactured under licence to Ceilcote Air Pollution Control of the USA. Pilot plants are available for site trials.

Vertical Packed Towers

This is the most efficient scrubber design for gas absorption, as it offers true counter-current flow with the gas stream typically moving vertically upwards through the tower and the scrubbing liquid passing downwards counter-current to the gas stream. The tower contains a bed of packing where the gas stream containing pollutants contacts the liquid. After being scrubbed, the gas then passes through a mist eliminator to prevent scrubber solution carry-over.

Horizontal Crossflow Scrubbers

The gas stream flows horizontally through the packed scrubbing vessel, where the gas stream containing pollutants contacts the liquid. The scrubbing liquid is irrigated on the top of the scrubber and flows downwards across the gas stream, hence the name crossflow. After being scrubbed, the gas passes through a mist eliminator to prevent scrubber solution carry-over, and the scrubbing liquid passes into a sump beneath the gas stream. Horizontal crossflow scrubbers are ideal where ceiling height is limited, where roof mounting is required, or when multiple beds are needed.

Vertical packed bed scrubber removing ammonia from gas stream, ex biosolids building at wastewater treatment plant.

Two-bed horizontal packed bed scrubber removing formaldehyde from press gasses at particle board plant.

Scrubbers

... Venturi Scrubbers

Venturi scrubbers are used for scrubbing gases with moderate particulate loadings, and are particularly effective in the sub mircon range, and with soluble gases. The basic process is the same as for packed bed scrubbers, except that capture by inertial impaction is more important. Inertial impaction is promoted by accelerating the gas stream and the resulting turbulence results in solid particles impacting scrubbing liquid particles. Venturi scrubbers are manufactured under licence to Ceilcote Air Pollution Control of the USA. Pilot plants are available for site trials.

Long Throat Venturi Scrubbers

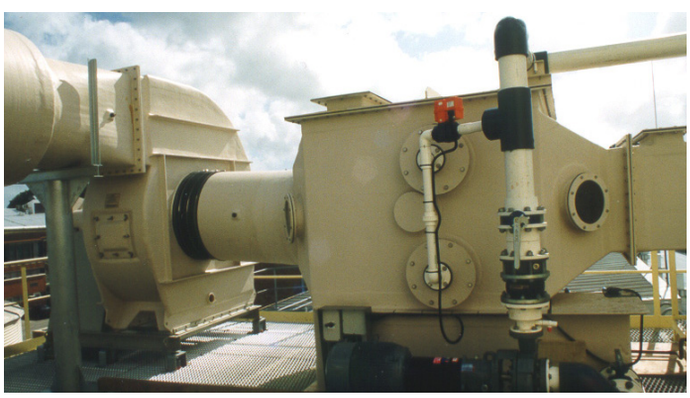
Long throat venturi scrubbers provide removal efficiencies in excess of 99% when removing solid and liquid particulates of 0.1 to 5 microns from corrosive gas streams. They effectively remove submicron particles by inducing Brownian motion (side-to-side as well as forward) to facilitate collision with liquid droplets formed in the throat. They can also remove noxious gases with collection efficiencies as high as 95% where the gases are reactive or soluble in the scrubbing solution. The venturi throat size is selected to achieve the design velocity and pressure drop for optimum mixing contact, both of entrained particles in the gas stream, and the liquid droplets generated in the liquid stream.

Multi-Throat Venturi Scrubbers

Multi-throat venturi scrubbers use a series of rods to create the throat where the gas and liquid are accelerated to bring intimate contact and effect particulate collection. They can be designed for very low pressure drop, thus minimising energy consumption, and are ideal as a pre-treatment device to remove particulate ahead of a packed tower scrubber.

Eductor Venturi Scrubbers

Eductor venturi scrubbers use liquid pressure to provide the gas driving force, i.e. a fan is not required. They are ideal for applications requiring high liquid to gas ratios, and are often used for emergency scrubber systems.



Above: Multi-throat venturi scrubber removing particulate from vents from food processing operations. Right: Eductor venturi for collecting toxic dust.

Scrubbers

... Void Tower Scrubbers

Void tower scrubbers are the original wet scrubber before packings were developed to enhance the scrubbing action; thus, scrubbing efficiencies are lower than packed towers of the same dimensions. However, void tower scrubbers are preferred for installations where solids deposition can occur as this would foul a packed bed. In void tower scrubbers, solids can only deposit on the vessel walls and this has minimal effect on scrubbing performance. This deposit can be subsequently cleaned in a very short time. Void tower scrubbers incorporate one or more spray nozzles spraying the scrubbing liquid into the void tower at different elevations.

FEATURES

- Spray nozzles produce relatively large liquid droplets which minimises mist carry-over.
- Pressure drop ranges from 50 to 100 mm WC.
- Larger entrained particles are collected by inertial impaction with liquid droplets.
- Solids deposited do not significantly affect the void tower scrubber's performance.
- Gas and liquid flows can be counter-current for best performance or co-current if layout requires.

Void tower scrubbers at fertiliser plants, for removing fluoride gases. Silica deposition requires use of void tower scrubbers.

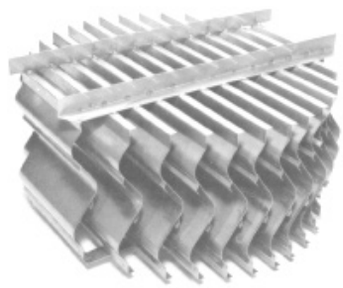
Scrubbers

... Cyclones & Mist Eliminators

Wet Cyclones

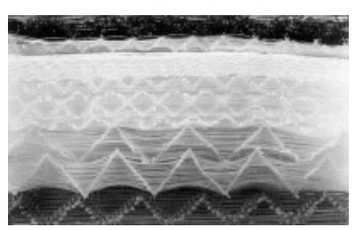
Wet cyclones force the gas flow into a spiral flow pattern. Centrifugal force amounting to several hundred gravities acts on entrained particles forcing them against the wall of the cyclone and thus collecting them. They are often used as the mist elimination device following a venturi scrubber.

Chevron Curved Blades



Chevron-type mist eliminators work on the principle of direct impaction combined with centrifugal force. The liquid droplets are collected in a series of troughs located in bundles of parallel curved blades. The design velocity for Chevron Curved Blades is high, minimising the size of equipment.

Kimre Composite Mesh Pads



Kimre Composite Mesh Pads work on the principle of direct impaction. The liquid droplets are collected in direct collision with structured, interlocked monofilaments within the mesh pad. Kimre mist eliminators have several layers of differing coarseness. Heavy loads of solid particulates or liquids can be stopped with coarse styles while less coarse styles eliminate small liquid droplets.

Left: Wet cyclone at fertiliser plant, for removing liquid droplets after void tower scrubbers.
Right: Kimre mist eliminator removing acid droplets and water mist from air stream.

Scrubbers

... Biological Scrubbers

Biological scrubbers treat polluted air biologically. The polluted gas stream is contacted with a scrubbing solution in a vessel packed with an inorganic support material. On the surface of the packing, a biofilm of pollutant degrading microorganisms forms, which aerobically degrade the absorbed pollutants. Since the packing is made of inert material, a continuous supply of mineral nutrients (N,P,K+traces) is needed. Biological scrubbing action minimises chemical consumption for low ongoing operational cost. The biological scrubbers are built to designs by USA Professor Marc Deshusses, leading international researcher in biological techniques for air pollution control.

Features

- Gaseous contaminants can be removed to over 99% efficiency rate, depending on the bed depth and scrubber design.
- Chemical consumption is eliminated or greatly reduced compared to a chemical wet scrubber. The only requirement is an occasional dosing of nutrients.
- Fabricated in corrosion resistant fibreglass for low maintenance.
- Standard units include access doors, circulation pump, spray headers, piping connections, nozzles, internal structure supports, packing, support plates and hold-down lugs.
- Small footprint compared to soil bed filter

Pilot Plant Available

Site trials with ARMATEC's pilot plant enables accurate scale up to the full unit. Please contact ARMATEC for details of pilot plant availability.

ARMATEC designed biological scrubber removing H_2S at Sydney WWTP.

Biological scrubber removing H_2S from gas stream ex sulphur melter at fertiliser plant.

Scrubbers

... Carbon Bed Adsorbers

Carbon adsorption beds are used for removing volatile gases and odours from air streams, especially where the concentration of the volatiles is relatively low and the air volume is relatively large. Activated carbon is a crude form of graphite with a highly porous structure. The pore sizes vary from visible cracks and crevices, to cracks and crevices of molecular size. Intermolecular attractions in these smallest pores result in adsorption forces which cause condensation and capture of the volatile gases.

Features

- Flexible design - upflow, downflow or crossflow depending on project requirements.
- Life of carbon dependent on quantity of volatiles adsorbed and mass of carbon installed.
- Different grades of carbon for different applications.
- Carbon impregnated with caustic compounds can be used to improve removal efficiencies for compounds such as H_2S.
- Particularly useful for removing compounds that are not water soluble and can't be removed by a wet scrubber.
- Units are designed for easy removal and replacement of carbon.
- Standard shell design provided for pressure range of vacuum -150mm WC to +250mm WC.
- Adsorber shells are constructed in corrosion resistant fibreglass for long low maintenance life when used for handling corrosive air streams.
- Pilot plant available for site trials.

Carbon beds adsorbing H_2S odours from landfill gas stream.

Carbon Bed Adsorbers

... With fan for Larger Pump Stations

ARMATEC

Description

Carbon bed adsorbers are ideal for removing sulphur odours and volatile gases from air released from municipal pump stations. Generally the average inlet hydrogen sulphide concentration is low (less than 10ppm), and zero odour is allowable in the discharge. Carbon beds are simple to operate and require minimal maintenance. For larger pump stations, and ones receiving septic sewage, a fan ventilated system is required to avoid build up of hydrogen sulphide gases in the pump station, which would result in corrosion of the concrete.

Features

- Standard units are upflow.
- Standard sizes from 50 l/s to 1,000 l/s. Larger units custom designed as required.
- Standard carbon life of 1 to 2 years.
- Corrosion resistant fibreglass construction.
- Fan is separate for ease of servicing.
- Minimal footprint compared to alternatives.

Activated Carbon

A moisture tolerant grade of carbon is used so humidity control with heaters is not required.

Optional Extras

- Inlet filter for particulate, grease etc.
- Inlet ducting.
- Any choice of colours
- Probes for quick check of carbon usage on H_2S.
- Side accessway for easy removal of carbon.
- Ports for instruments to log gas concentrations.
- Noise attenuation enclosure over fan.

LCCs - Life Cycle Costs

LCC analyses are available for ARMATEC carbon bed adsorbers on request. At average hydrogen sulphide concentrations less than 10ppm, a carbon bed adsorber offers the lowest LCC and the smallest footprint.

Standard ARMATEC Carbon Beds

Model Number	Max Airflow, litres/sec	Footprint diam, metres
CB 30-4	113	0.96
CB 36-4	142	1.10
CB 42-4	170	1.27
CB 42-6	240	1.27
CB 48-4	180	1.40
CB 48-6	280	1.40
CB 48-8	490	1.40
CB 60-6	380	1.70
CB 60-8	680	1.70
CB 60-10	760	1.70
CB 72-10	1000	2.03
CB 80-10	1100	2.20

Carbon bed with fan on a larger municipal pump station in Tauranga. The carbon bed solved the hydrogen sulphide odour problems experienced by the neighbour.

Green Dome Odour Filters

... With passive ventilation - no fan

Description

Green Dome Odour Filters are purpose designed carbon bed adsorbers for removing odours and volatile gases from air vented from smaller pump station, i.e. when it "breathes" as the wastewater level rises and falls. There is no fan. Green Dome Odour Filters are ideal on smaller pump stations when odour concentrations are low, and when zero odours are required in the discharge. Green Dome Odour Filters require no operator input or maintenance, other than changing the carbon every two to five years.

Features

- Guaranteed odour removal*
- Proven carbon adsorption technology
- Low profile for minimum visual impact
- Inlet ducting below ground out of sight
- No fan, heater, or moving parts to service
- Zero power consumption
- Compact light weight design
- Robust fibreglass construction
- Corrosion resistant to hydrogen sulphide
- Carbon life 2 to 5 years
- Carbon easily changed

Activated Carbon

Green Dome Odour Filters use a grade of carbon that is moisture tolerant, eliminating the need for humidity control with a heater. The carbon is supplied in paper bags to loose fill as standard.It can also be supplied in custom made mesh bags, to minimise carbon handling.

*Odour Free Guarantee

ARMATEC guarantees that the Green Dome Odour Filter will make a pump station odour free with the following conditions:

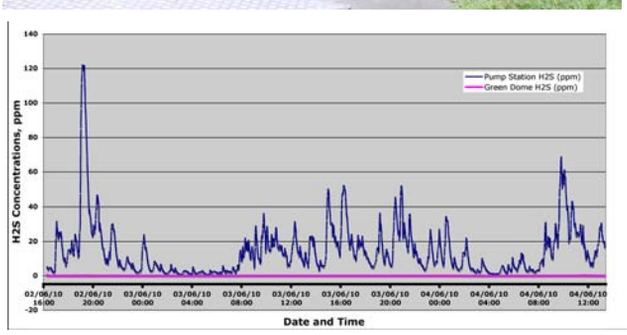
- Unit is installed as specified
- Pump station is fitted with sealing lid
- All other penetrations are sealed
- Carbon is not spent or used up.

Design Details

The Green Dome Odour Filter is designed to have a very low air velocity and thus very low pressure drop. A range of sizes is available to suit various airflows and hydrogen sulphide loads.

Green Dome Odour Filters

Model Number	Recommended Maximum Airflow, litres/sec
GD 12	3
GD 16	6
GD 20	10
GD 24	14
GD 30	20
GD 36	33
GD 42	45
GD 48	56



Green Dome Odour Filter installed at Mangawhai. The plot shows the H_2S in the pump station spiking to 120ppm, but is zero in the Green Dome outlet.

Why Fibreglass?

Corrosion Resistant
Fibreglass has excellent chemical resistance to many chemicals; subject to the correct resin choice (see page 26 for details).
- **Vinyl ester** resins handle acids, alkalis and bleach solutions to temperatures close to 100ºC.
- **Isophthalic polyester** resins handle the typical acidic conditions found in most duct systems such as at wastewater treatment plants.

Light Weight
Handling, transport, lifting, and installation are all simplified with fibreglass's light weight. Small capacity lifting equipment can be used for lifting and placing most duct work.

Smooth Internal Surface
Smooth internal surfaces facilitate cleaning and provide low friction loss.

Weather Resistant
As fibreglass is corrosion resistant on both the outside and inside, there is no need for any further protection or painting on the outside - everything is done.

Proven Performance
Fibreglass evolved in the chlorine and acid solutions of the pulp and paper mills, and now it is proven in performance across all industries.

Leak Free Joints
Standard butt and strap joints (see page 27) are leak free and stronger than the original material. Leakages and infiltration are thus totally minimised. Rubber ring joints can be completely eliminated.

Easy To Modify
On-site modifications and additions are easy to do; simply cut with hand tools, then butt and strap anywhere at any time (see page 27).

Versatile
All products are possible. Challenge us with your ideas and requirements. Fibreglass is ideal where there are complex curved surfaces, and where you require a number of identical products. The external surface can be pigmented to a colour of your choice, e.g. to identify a particular line.

Standards & QA
International standards for design and fabrication, and associated quality assurance procedures are all well established making it easy to monitor and control every step of the way. ARMATEC documents fabrication steps with QA logs.

Total Product Range
The total ARMATEC fibreglass product range allows you to install a total ventilation system; covers, hoods, fans, scrubbers, stacks, tanks, protective coatings and other ancilliary equipment. The ventilation gases need never come into contact with any other material, eliminating the major problems of joining dissimilar materials.

Low Life Cycle Cost
Fibreglass has a low life cycle cost in comparison with other materials; the initial installed cost is often similar, it has an indefinite life in most ventilation systems, and the maintenance and cleaning requirements are minimal.

Specifying Fibreglass

A suggested specification:

All fibreglass covers & hoods, ducts, dampers, scrubbers, fans and stacks are to be manufactured by Armatec Environmental Ltd, and are to be designed to handle the loads specified. Design is to be to industry best practice. Manufacture is to be by the contact moulded method for maximum chemical resistance, and in accordance with international standards including AS 2634 “Chemical Plant Equipment Made from Glass-Fibre Reinforced Plastics (GRP) Based on Thermosetting Resins” using premium corrosion resistant isophthalic resins or vinyl ester resins. A 2.5mm corrosion barrier shall be included on all equipment. All site joints are to be butt and strap, and are to be done by a suitably experienced person trained by ARMATEC.

FRP is resistant to many aggressive chemicals making it ideal for corrosive mixtures.

FRP is light weight making it easy to handle, transport and install. Always use nylon or fabric slings, sit on cradles, and avoid point loads at all times.

Why ARMATEC?

12 Reasons to choose ARMATEC as your supplier

Highest Chemical Resistance
All products are 75% resin, as they are made and assembled using the contact moulded method. This manufacturing method gives the highest resin percentage in the final product, and this translates to the best chemical resistance possible, as it is the resin that gives fibreglass products chemical resistance.

World Class Technology
With more than 30 years of experience in industrial fibreglass work, plus close links and licences to world technology leaders, you can be assured that you will be offered the most up to date and applicable technology.

Documented Case Histories
Successful case histories of installations in New Zealand, and around the world, allows us to stand behind our guarantees, proving our products perform for years to come.

Guaranteed Performance
Products are guaranteed to perform in the service conditions stated. If they fail we will replace them.

Highly Experienced Tradesmen
Our tradesmen have many years experience in industrial fibreglass, working at large and small industrial sites. Many customers ask for our senior tradesmen by name. We have been servicing industrial sites longer than some site staff have been employed, and thus know your equipment and site.

Certified Tank Manufacturer
ARMATEC is certified by ERMA under the HSNO Act to manufacture fibreglass tanks.

Quality Assurance
With our ISO 9001 systems in place you are assured of quality workmanship with supporting QA documentation. Our management actively supervises jobs to ensure quality is not compromised. Compliance with client based systems is our forte.

Fully Insured
For your peace of mind we have full insurance, including $10 million public liability insurance.

Specialists at Site Work
When you have a shutdown, or an urgent job, we know what this means. We will work to your timetable and meet it, and are proud that we have never delayed a startup.

Responsive to Customer Needs
Projects are never straight forward, frequently requiring changes in design and methodology as the project develops. We understand this, and will help you optimise the project by being responsive to your needs.

Industry Leaders
Armatec personnel are at the forefront of the NZ Composites Industry and have an ongoing leadership involvment in the Composites Association of NZ (Inc.).

Chemical Engineers
Your chemicals and processes are not a mystery to us. Our experienced chemical engineers understand what you are doing, and can make the best product recommendations to you.

ARMATEC Capability





ARMATEC supplies equipment and specialist products to help industry and local authorities reduce emissions to the environment, and has established a reputation for high quality corrosion resistant products for tough environments. This includes air pollution control products such as wet scrubbers; fibreglass fans for corrosive air streams; coatings to resist aggressive chemicals; fibreglass fabrications including tanks, pipes, manholes, covers etc; and wastewater treatment products.

Chemical Resistance Data

FRP resists a wide range of chemicals depending on resin selection. The two most commonly used resins are:

- **Vinyl ester for acids, alkalis and bleach**
- **Isophthalic polyester for mild acids**

Materials	Carbon Steel 1020	Stainless 316	FRP Isophthalic	FRP Vinyl Ester
Acetic Acid	NR	R	NR	R
Acid Chloride Salts	NR	NR	R	R
Bleach	NR	NR	NR	R
Chlorine Wet	NR	NR	NR	R
Chlorine Dioxide	NR	NR	NR	R
Hydrochloric Acid Dilute	NR	NR	R to 5%	R
Hydrochloric Acid Conc	NR	NR	NR	R
Hydrofluosilicic Acid	NR	NR	NR	R
Hydrogen Sulphide	NR	NR	R	R
Lactic Acid	NR	R	R	R
Nitric Acid Dilute	NR	R	R to 5%	R to 40%
Nitric Acid Conc	NR	R	NR	NR
Phosphoric Acid Dilute	NR	R	R to 5%	R
Phosphoric Acid Conc	NR	R	NR	R
Salt Water	NR	NR	R	R
Sodium Hydroxide Dilute	NR	R	NR	R
Sodium Hydroxide Conc	R	R	NR	R
Sodium Hypochlorite	NR	NR	NR	R
Sulphuric Acid Dilute	NR	R to 5%	R	R to 75%
Sulphuric Acid Conc	R	R	NR	NR

R = Resistant, NR = Not Resistant. Consult ARMATEC for more detailed information.
For example there are temperature limitations to almost all the data given above.
Consult ARMATEC for chemical resistance to other chemicals.

Butt & Strap Jointing

The simplicity of a butt and strap joint is demonstrated below. Please consult ARMATEC for full instructions and training. Use only approved materials for joints.

1. *Pipe ends are cut square, sanded to clean material, butted together and joined with ARMABOND vinyl ester putty. Once the putty is cured, the joint is ready to strap. The surfaces are primed just prior to strapping.*

2. *Pre-cut layers of glass reinforcing are saturated with resin and consolidated to remove trapped air. This strap is then placed around the joint. Three to four layers of glass can be done at once.*

3. *The strap is consolidated with a ribbed roller to remove entrapped air and thus ensure a leak free joint. This process is repeated until the required thickness is reached.*

4. *Surfacing tissue is applied as the final layer to achieve a smooth spike free finish. Once cured the joint is resin coated.*

Standards & Quality Assurance

Standards to Specify:

- AS 2634: Chemical Plant Equipment Made from Glass-Fibre Reinforced Plastics (GRP) Based on Thermosetting Resins. Good all round standard used in NZ and Australia. Still widely specified and used. In process of being superceded
- BS 4994: Design and Construction of Vessels and Tanks in Reinforced Plastics - for tanks and pipes especially
- EN 13121: GRP Tanks and Vessels for Use Above Ground - new European standard
- ASTM RTP1: Reinforced Thermoset Plastic Corrosion Resistant Equipment - USA standard includes pressure vessels
- AS/NZS 3571: Glass Filament Reinforced Thermosetting Plastics (GRP) Pipes - Polyester Bases - Water Supply, Sewerage and Drainage Applications - FRP pipe for public utilities
- AS/NZS 2566 - for buried flexible pipelines
- AS/NZS 1170 - for seismic and wind loads
- ANSI/AWWA M45 - Fibreglass Pipe Design Manual, 2nd Edition
- ANSI/AWWA C950-01 - AWWA Standard for Fibreglass Pressure Pipe

Corrosion Barrier

Standards AS2634, BS 4994, EN 13121, and ASTM RTP1 all require a 2.5mm corrosion barrier. This is included as standard in all ARMATEC products.

Quality Assurance Available:

- QA checks and logs during manufacture
- Post fabrication thickness checks
- Post cure Barcol hardness checks
- On site QA logs for coatings and linings
- Coatings and linings - sparktesting and thickness checks
- ISO 9001 - materials traceability and design audits
- Standardised laminate testing (see table below)

Barcol Hardness testing to check laminate is cured

ARMATEC Quality Assurance Example:

AS 2634 specifies that, in order to use the minimum thicknesses stated in the standard, a manufacturer must produce a FRP laminate that has certain minimum properties. The table at right lists values of the the ultimate strength of various thickness ARMATEC FRP laminates and compares them to the minimums as per AS 2634. The ARMATEC FRP laminates exceed the minimums in all cases.

ARMATEC Standard Laminate Testing

Thickness	AS 2634 Minimums	Armatec Laminates*	Exceeds Minimums
3.1 mm	57 MPa	103 MPa	+ 80%
4.6 mm	68 MPa	127 MPa	+ 87%
5.9 mm	77 MPa	107 MPa	+ 39%
9.7 mm	100 MPa	124 MPa	+ 24%
10.3 mm	100 MPa	167 MPa	+ 67%

* By Materials & Testing Laboratories Ltd to AS 1145

Handling Fibreglass

Fibreglass is strong, and is lighter and more flexible than steel. It is, however, subject to cracking and chipping if proper handling and transporting methods are not followed. Never under any circumstances apply a point load to fibreglass, as this will cause damage.

1. Good Rigging Methods
Use OSH guidelines and good rigging methods at all times. Use an attached rope to guide any lift. Keep people clear and ensure the appropriate safety equipment is used.

2. Lifting Vessels & Pipes
Where lifting lugs are provided, these should always be used. DO NOT LIFT OFF NOZZLES. For vessels and pipes, place a sling around the vessel or pipe and choke it through the eye of the sling, and this distributes the load evenly. Ensure the sling cannot slip off during the lift. Do not place a hook in the ends of a pipe.

3. Use Nylon or Fabric Slings
Use only approved nylon or fabric slings for lifting or moving fibreglass equipment. DO NOT USE CHAINS OR CABLES UNDER ANY CIRCUMSTANCES.

4. Laydown: Avoid Point Loads
Ensure there are no sharp point loads under any fibreglass equipment when loading onto a truck or onto the ground. Purpose built cradles are the best way of handling large fibreglass items; these are available from ARMATEC and are to be returned after use. Ensure no point loads are placed on any nozzles or pipes. Sharp objects such as stones can cause point loads that result in damage. Ensure the fibreglass equipment is restrained so that it cannot roll away or be moved by wind. Store out of the way of working machinery and vehicles.

5. Moving Around at a Site
Fibreglass equipment is light in weight and can be manhandled at a site if lifting equipment is not available, for example by rolling or sliding. Sharp objects such as stones must be avoided by using sledges or planks. When righting a vessel from the horizontal position, care should be taken that the bottom corner is cushioned with soft material to prevent damage. If entering a vessel or pipe, wear soft soled footwear and provide protective coverings to save the surface from damage due to the dropping of equipment or tools.

6. If Damage Occurs
Advise ARMATEC immediately. Damage is usually limited to a small spot and can be easily repaired before final installation of the equipment.

7. Fibreglass Resins
Materials for site joints are hazardous and flammable. They must be stored in a secure and dry location, away from sources of ignition. Store in the original containers from ARMATEC.

Frequently Asked Questions

Q: How long will fibreglass last?
A: Indefinite. The design life is 50 years. Fibreglass has been around in industrial service for around 50 years. ARMATEC installations after 25 years still work as well as the day they were first installed. ARMATEC installations generally outlast the life of the process. A number of our customers have been able to sell their fibreglass ducting and equipment after the plant reaches the end of its life.

Q: How difficult is FRP to install for a contractor with no FRP experience?
A: Relatively easy. ARMATEC offers training for contractors; either at site or in ARMATEC's factory. Some customers prefer ARMATEC to do all installation work. Others have their contractors do civil works and structural steel etc, and contract ARMATEC to do the specialist jointing.

Q: How does FRP compare cost wise with alternative options?
A: Typically ventilation projects involve corrosive gases. FRP has a lower intial cost than stainless steel, and lasts longer. The result is a LOWER LIFE CYCLE COST.

Q: How about leaks?
A: The butt and strapping of every joint in ducting and scrubbers gives leak free joints, especially as many of the joints are done in the factory. This ensures corrosive and noxious gases are contained. Generally fans are sited after the scrubber, thus gases with the highest pollutant loadings are under negative pressure and so any leaks would be inward.

Q: What about protection from UV radiation?
A: All FRP equipment includes a pigmented exterior, usually in a pastel colour of your choice. The pigments act like a sunscreen and shield the FRP structure from UV radiation, reducing any deterioration to an absolute minimum.

Q: What cleaning schedule should I adopt with FRP?
A: The smooth internal surfaces of the fibreglass greatly reduces solids buildup. If solids deposition is a problem, ducts can be flushed with water. This does need addressing at design stage so that falls can be built into the duct network and clean out ports installed.

Q: Are fibreglass dust and resins dangerous?
A: All dusts are harmful to the lungs, and appropriate dust protective masks and safety glassses should be worn when cutting and grinding fibreglass. The resins and clean up solvents are flammable so must be kept away from naked flames. The OSH TWA (time weighted average) for styrene is 50ppm, and this concentration will never be reached in a properly ventilated space. If working inside a vessel, provide ventilation and wear a carbon based protective mask. Never take solvents into a confined space under any circumstances.

Ventilation System Photos

Photos of fibreglass ventilation systems are presented in the following pages, to give you ideas for your projects and assist you in understanding the benefits of fibreglass.

Complete ventilation system at a fertiliser works: hoods, ducts, void tower scrubbers, cyclone, fan and stack. Removes fluoride fumes from den, granulator, conveyors and other areas. Scrubbers reduce fluoride emissions to less than 0.25 kg/hr to meet resource requirements.

Fibreglass Ducting

... At Wastewater Treatment Plant

Ventilation system continues from photo at right. Large main duct (front left) connects to main ventilation and scrubbing system. Note manual damper for balancing air flow rate.

Fibreglass Ducting

... At Wastewater Treatment Plant

Ventilation system at biosolids plant at wastewater treatment plant. Fibreglass ducts connect to strategic process points to collect dust and fumes. Ducts are irrigated and sloped to flush solids away.

Fibreglass Ducting

... During Installation at WWTP

Ventilation system at biosolids plant at wastewater treatment plant during installation. Duct support structures are pre-installed for elevated ducts, but at ground level temporary supports can be used first, and permanent supports installed later.

Fibreglass Ducting

... At Food Processing Plant & WWTP

Top: Complete system at food processing plant, treating odours and particulate.
Bottom: Fibreglass duct network taking odours to soil bed filters.

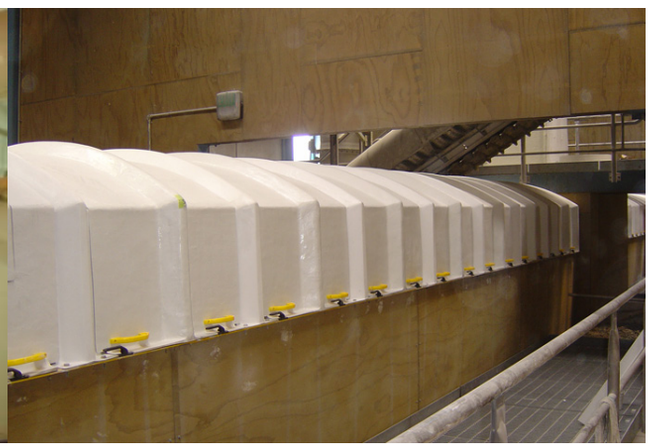
Fibreglass Tank Covers

... For wastewater treatment plants

Top: Segmented tank covers being trial assembled at ARMATEC before despatch.
Bottom: Fibreglass covers by ARMATEC installed at wastewater treatment plant in Perth.

Fibreglass Hoods

... Endless variety



Fibreglass covers and hoods are ideal in corrosive environments. There is no limit to the shape or size possible. They are light in weight, so easy to remove to service equipment.

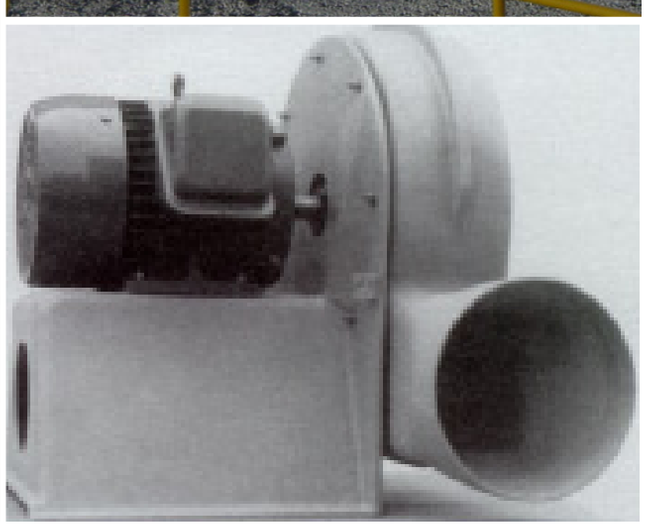
Fibreglass Fans

... Axial & Centrifugal Models

Left: Axial fans, duty and standby, providing fresh air to biosolids processing building at WWTP.
Right: Large and small centrifugal fans being assembled ready for despatch.

Fibreglass Fans

... Belt Driven & Direct Drive Models



Left: Centrifugal fans installed at fertiliser plant (top), and pulp and paper mill (bottom).
Right: Small centrifugal fans at wastewater treatmetn plant (top), and a direct drive fan (bottom).

Biological Scrubbers

... For H_2S removal

Left: Biological scrubber removing H2S. Top right: Biological scrubber pilot plant at pump station. Bottom right: ARMATEC designed biological scrubber at Sydney WWTP.

Carbon Beds

... For H_2S removal, with & without fan

Carbon bed adsorbers for H_2S and other volatile organic gases, all force ventilated with fans.

"Green Dome" carbon bed adsorbers for H_2S odours. Passive ventilation - no fans.

Scrubbers

... Horizontal & Vertical Packed Beds

Top left: Two stage horizontal packed bed scrubber for tannery odours.
Bottom left: Vertical packed bed scrubbers, rectangular in shape, for annodising fumes and mists.
Right: Vertical packed bed scrubber pilot plant available for hire for trial work.

Scrubbers

... Venturi and Vertical Packed Towers

Left: Emergency chlorine scrubber system consisting of eductor venturi at left, and vertical packed tower at right. When there is a chlorine leak, an alarm starts the pump and the eductor venturi provides the suction required to ventilate the room. The chlorine is absorbed into a caustic solution stored in the tank, and circulated through the eductor venturi and packed tower.
Right: Vertical packed tower for hydrogen sulphide odours at a tannery.

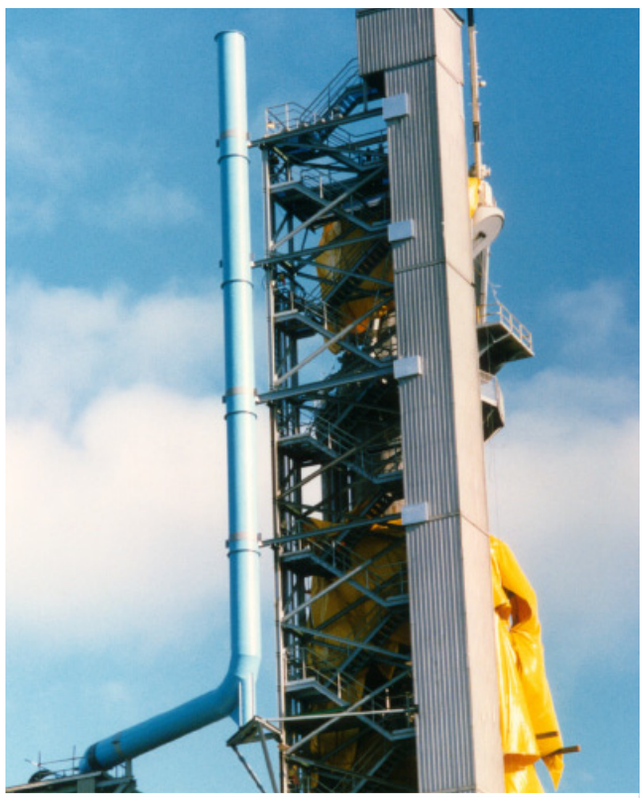
Scrubbers

... Cyclones, Mist Eliminators, Gas Stripper

Left: Cyclones at two fertiliser plants, last stage of mist elimination before discharge to stack.
Right top: Kimre mist eliminator for acid mist collection at battery plant.
Right bottom: Gas strippers removing carbon dioxide from water.

Stacks

... The Final Discharge Point



Left top: Fanstack for forced draft cooling tower. Left bottom: Stack for fertiliser plant being lifted into position. Right top: Stack for chlorine fumes at pulp and paper plant. Right Bottom: Stack at WWTP with diffuser.

Contact Details

Thank You

Your time taken in perusing this publication is appreciated, and we trust this publication is helpful to you. If there are other subjects you would like to see covered in the next edition, please contact us and pass on your ideas. We welcome your feedback.

Contacting Us

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