

THE PALL GAS SOLID SEPARATION SYSTEM FOR THE CHEMICAL PROCESS, REFINING, AND MINERAL INDUSTRIES

Advanced Metal Filters for Critical Gas Solid
Separation Problems.

PALL

PALL

Pall Process Filtration Company
A Division of Pall Trinity Micro Corporation
East Hills, New York 11548-1289
(516) 484-5400 • 1-(800)-645-6532
Telex: 968855 TWX: 510-223-0606
FAX: 516-484-5228

International offices and plants: Pall Corporation, East Hills, New York, USA; Pall Europe, Ltd., Portsmouth, England; Pall Filtrationstechnik GmbH, Frankfurt, Germany and Warsaw, Poland; Pall Industrie s.a., Paris, France; Pall Italia, s.r.l., Milan, Italy; Pall (Canada), Ltd., Toronto, Ontario; Nihon Pall, Ltd., Tokyo, Japan; Pall Industrial do Brasil, Ltda., São Paulo, Brazil; Pall Fluid Clarification Pte. Ltd., Singapore; Pall Filter Ges.m.b.H., Vienna, Austria; Pall (Schweiz) AG, Basel, Switzerland; Pall España S.A., Madrid, Spain. Distributors in most major industrial areas of the world.

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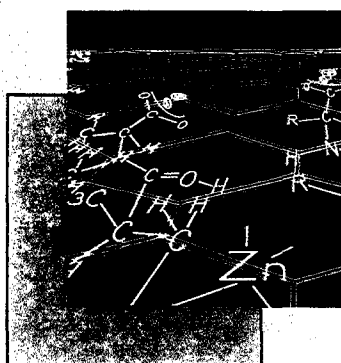
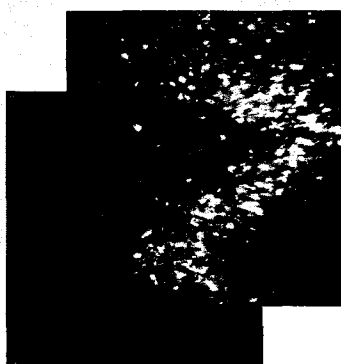
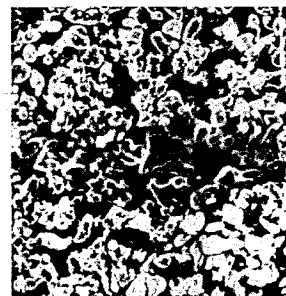


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PALL SERVICES

Unique Scientific and Laboratory Services

The cornerstone of Pall's philosophy is service to customers. Not only in product quality and prompt delivery, but also in problem solving, system recommendations and in the sharing of scientific information.

Pall's Scientific and Laboratory Services (SLS) Department is composed of highly qualified scientists and engineers, supported by professional laboratory personnel and extensive specialized laboratory facilities. A unique group of SLS technical specialists is exclusively devoted to the Chemical Process, Refinery and Minerals industries. Not only are they skilled in performing on-site testing but as a result of actual start-up experience are able to relate test work to plant operations.

SLS staff scientists will work closely with a customer in solving difficult contamination control problems and in the selection of the most efficient and economical Pall gas solid separation systems. This frequently involves extensive work in the SLS laboratories and in some instances on-site.

SLS support is offered at no cost and is available on request. Pall is happy to bring customers the scientific means of finding reliable and cost-effective solutions to problems. Our long experience with innumerable installations has given us the knowledge and insight to resolve solids separation problems promptly and efficiently.



Start-up services

Pall insists on complete customer satisfaction every step of the way. This traditional concern doesn't stop when a Pall system is delivered. We're there at your side to get you on-stream as swiftly and efficiently as is possible.

That's why Pall provides a complete and thorough start-up service to help detect and eliminate any 'bugs' and get you into full-scale production in record time.

After your system is delivered, a trained Pall technician will visit your plant and check all components thoroughly. The entire installation will be inspected in minute detail to ensure that it conforms to specifications. This is one more reason the Pall name is respected around the world.

Cleaning services for long-term performance

If it should ever become necessary to clean Pall porous metal filters, take advantage of our expertise in the field. Backed by sophisticated testing equipment, Pall scientists and engineers will recommend and develop effective cleaning procedures specific to your application.



These are just some of the services that set Pall apart from any other company in the filtration field. Put Pall dependability and expertise to work in your process.

SIZING AND SELECTION

Sizing

Divide gas flow rate (ACFM) by the recommended sizing (8-10ACFM/ft² for initial sizing) to determine the total filter area required.

Each standard GS filter element provides 4 ft² of filter area. Number of elements = total area/4.

Select the vessel from the table below that will accommodate the required number of elements.

Element Selection

Element Part Number: **GS** ☐ ☐ ☐ ☐ ☐ ☐ ☐

Alloy	
no code:	316L medium/304 hardware
I:	All Inconel 600
M:	All Monel 400
N:	All Nickel 200
X:	All High nickel/chrome
7:	All 347SST
3:	All 310SST
4:	All 304SST

Medium
P: PSS

Medium Thickness
02: 1/16 inch
03: 3/32 inch
04: 1/8 inch

Blowback
JP: Jet Pulse
RF: Reverse Flow

Grade
H: 1.3µm absolute
F: 2.8µm absolute

Fitting
W: Welded
F: Flanged

Options
F: Fail Safe Fuse
B: Banded triads

Typical Filter Vessel Characteristics

Number of GS Elements	Vessel Diameter (inches)		Nozzles (inches)	Vessel Length (inches)	Differential Pressure Loss Factor	
	Jet Pulse/Reverse Flow	Downdraft			K _{VRF}	K _{VJP}
5	10	12	3	100	7.5x10 ⁻⁵	1.9x10 ⁻⁴
10	14	16	4	110	2.4x10 ⁻⁵	5.1x10 ⁻⁵
19	18	22	6	120	4.7x10 ⁻⁶	1.3x10 ⁻⁵
31	22	26	8	128	1.5x10 ⁻⁶	4.6x10 ⁻⁶
42	26	28	10	132	6.1x10 ⁻⁷	2.4x10 ⁻⁶
68	32	36	12	140	2.9x10 ⁻⁷	9.5x10 ⁻⁷
96	38	42	14	152	1.8x10 ⁻⁷	5.0x10 ⁻⁷
130	44	46	18	164	6.5x10 ⁻⁸	2.5x10 ⁻⁷
170	50	54	20	176	4.2x10 ⁻⁸	1.5x10 ⁻⁷

Notes: 1. Nozzle sizes as indicated are typical, RF 150lb. design.
2. The vessel length includes a 60° angle cone for solids discharge.

Vessel Alloy:

Carbon Steel is standard
Other alloys available, including refractory lined and jacketed vessels.

Design Pressure:

150 psig is standard
Other designs available up to 1000 psig.

Clean Pressure Drop:

Clean $\Delta P = \Delta P_{\text{vessel}} + \Delta P_{\text{filter elements}}$
 $= K_v \rho Q^2 + K_m \mu Q/A$

where K_v and K_m are loss coefficients for the vessel and filter medium respectively, ρ is the gas density in lb/ft³, μ is the viscosity of the gas at operating conditions in centipoise, Q is the gas flow rate in ACFM, and A is the filter area in ft². The terminal pressure drop at which the filter is blown back is determined by the customer to fit within the pressure drop available in the system.

K_v values are given in table: "Typical Filter Vessel Characteristics"

K_m values are: PSS Grade K_m (for 3/32" medium thickness)

PH	2.0
PF	0.45

Example

For a 3500 ACFM gas stream at 600°F containing catalyst particles with 15 percent smaller than 10µm, and a bulk density of 60 lb/ft³.

Filter area = 3500 ACFM / 10 ACFM/ft²
= 350 ft²

Number of elements = 350/4 = 87.5

Select a 38 inch diameter vessel containing 96 GS Series elements giving 384 ft² of filter area.

Actual flow density = $\frac{3500}{384} = 9.1$ ACFM/ft²

Select jet pulse blowback for these high density solids. Element part number: GSPH03FJP

Elements are 80 inches long, 4 ft² area elements constructed of 316L porous medium and 304 hardware, flanged to the tubesheet.

Filter medium grade: Select PH (1.3 µm absolute) due to high percentage of particles below 20 µm in size. The standard medium thickness of 3/32 inch is used.

The vessel specification is completed by providing required materials of construction, gasketing, design temperature and pressure, pressure vessel code and any special maintenance or other requirements.

Element Characteristics

Standard GS elements have the following characteristics:

Overall element length: 80 inches
Sections per element: 4 x 19 inches each

Element diameter: 2 3/8 inches

Element area: 4 ft²

Filter medium thickness: 3/32 inches (standard)

Maximum pressure drop: 100 psid up to 800°F (standard)

PALL. FOUR DECADES OF FILTRATION LEADERSHIP.

There is an increasing trend towards higher efficiency in gas solid separation and recovery processes throughout a wide spectrum of industries. This is being driven by:

- tougher environmental standards.
- the need to more efficiently recover expensive catalysts and other valuable products.
- the need to protect personnel and system components more reliably and safely.
- the economic benefits of enhanced energy conservation.

Traditional equipment, such as cyclones, bag-houses, electrostatic precipitators and scrubbers are not always able to meet industry's demanding levels of efficiency, economy, safety and energy conservation in gas solid separation processes.

Pall Corporation has been responding to these needs for over 40 years by developing systems which offer technically and economically feasible solutions to difficult gas solid separation problems.

At the heart of the Pall GSS System is the porous metal filter medium. Pall's patented method for sintering stainless steel powder formed the basis for the company's first product, PSS® porous stainless steel filter medium. This process led to the development of other types of porous metal media:

- Rigimesh® sintered woven wire mesh.
- Supramesh® medium, a sintered composite of metal powder and Rigimesh.
- PMM™ porous metal membrane medium, a thin sintered matrix of metal powder within the pore structure of woven wire mesh.
- PMF™ porous metal fiber medium, an extremely high dirt holding capacity medium.

This is the broadest array of metal filter media in the industry, and Pall Corporation is uniquely positioned to select the optimum type for each application. Sintered metal powder media are the filter media of choice for Pall GSS Systems, satisfying the following requirements:

- optimum pore size distribution to collect particles on the filter's surface and prevent particle penetration into the depth of the medium.
- pore size uniformity for full utilization of the filter surface.
- physical strength and durability to withstand the cyclic loads applied during reverse flow cleaning cycles.
- chemical and thermal compatibility with process conditions to ensure long life.

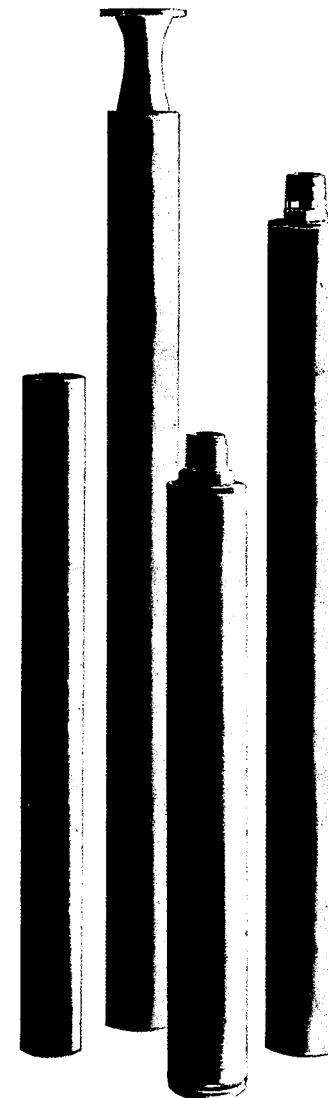
Pall is a highly integrated manufacturer, and a leader in the development and production of filter media by a variety of proprietary methods. Our capabilities range across a wider span than any other company in the field. In addition, Pall offers advanced capabilities in the design and production of sophisticated vessels that house the filter elements and devices.

Pall Corporation is a multinational organization with 5,100 employees at 38 locations in twelve countries. Our long-standing record of consistently strong growth continues today with annual sales approaching \$400 million.

We intend to expand our leadership by continuing to provide superior products and services to all our customers. To proceed with diligence, creativity and care every step of the way from research to the delivery of the finest products and personal service available today.

We call it *EESES*. We want to do what eases the way for you by providing *Ease of use, Economy of use, Safety, Efficacy and Service* with each product we sell, and in every part of the world.

For more information on Pall porous metal media see Publications PSS-700, PSS-733, PMM-734, and PMF-735.



FILTER MEDIA AND ELEMENT DESIGN

PSS: The superior sintered porous medium

Pall's sintered metal powder filter media, which are ideal for gas solid separation processes, have the following properties:

High particulate removal efficiency

PSS filters provide a very high efficiency of particle capture. Typically, more than 99.99% of the solids in the dirty inlet gas are removed on the surface of the filter medium. Pore dimensions are carefully controlled and cannot change in service. The result is quantitative solids separation, free of migration or unloading of particulate matter, and consistently superior effluent quality.

High permeability

A uniform distribution of interconnected pores represents up to 60% of the filter medium's volume. This provides low resistance to flow even at high flow rates up to 20ACFM gas/ft² filter area.

Temperature resistance

Sintered metal powder media are available for extreme temperatures ranging from -450°F to 1650°F. Standard medium fabrication is from 316L stainless steel. For high temperature processes above 800°F, filter media are available in other 300 series stainless steels, Inconel, Monel and other corrosion resistant alloys.

Corrosion resistance

The Pall patented sintering process retains the corrosion resistant properties of the alloys of which the media are made. These materials are compatible with most process gases, providing long, economical service life.

Element integrity and ruggedness

After all welding has been completed, each element is hydrogen annealed to fully stress-relieve and maximize corrosion resistance of the filter medium. Each element undergoes a non-destructive Bubble Point Test prior to shipment. This certifies the physical integrity as well as the rated efficiency of the filter element.

Physical strength

Sintered metal powder media are inherently strong and durable for long-term service. The media are formed into elements capable of withstanding the rigors of repeated cycles in the reverse flow direction.

Construction of GS series elements

Based on the experience acquired through hundreds of successful GSS System installations, Pall has developed the GS Series of filter elements. This series uses the superior PSS filter medium, and has been designed for optimum performance, life, reliability and safety of use. The features of the GS element design are:



Installation of GS filter elements into a 48 inch diameter tube sheet assembly.

GSS System filter recommendations

Filter Medium

PSS grade F for size range 20 μ m and larger.
PSS grade H for size range 1 μ m and larger.
Alloy compatible with process conditions.

Blowback method

Jet pulse for solids with a bulk density above 20 lb/ft³.

Jet pulse for high temperature (>800°F) processes, with Downdraft design for light solids.

Reverse flow for solids with a bulk density below 20 lb/ft³.

Fail Safe Fuse

For systems requiring maximum personnel and environmental protection, e.g., pyrophoric or radioactive materials.

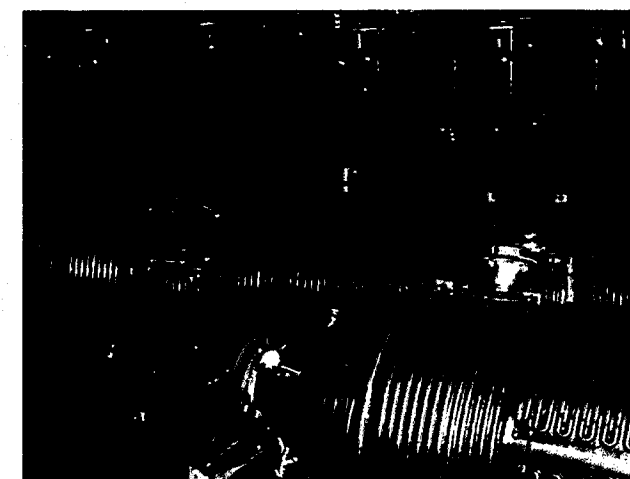
System Sizing

4-6 ACFM/ft² for nuclear fuel applications. 8-10 ACFM/ft² for other applications.

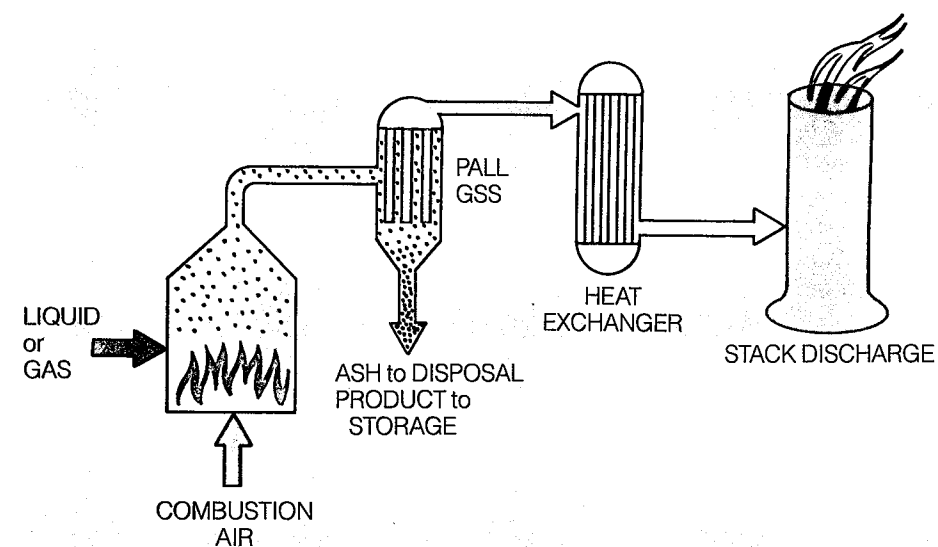
Control

Automated, pressure drop initiated blowback control.

GSS system for collection of Fumed Silica. GSelements and Fail Safe Fuses are constructed of Inconel.



Schematic of a Typical Incinerator or Furnace Operation



MINERAL PROCESSING AND RELATED INDUSTRIES

In the Mineral Processing and related industries, such as Nuclear Fuel Manufacture and Catalyst Production, solid intermediates and products are regularly handled in fine powdered form. There is a need to recover these powders from the off-gases of such sources as calciners, fluid bed dryers, incinerators and storage silos. The GSS filter provides the following benefits:

- High collection efficiencies of valuable products.
- Extremely low atmospheric emissions of pyrophoric (e.g., aluminum powder) or radioactive materials.
- Effective flame arresting characteristics provide a high level of safety in handling pyrophoric or explosion-prone powders. The porous metal filters are also fully grounded, reducing the possibility of electrostatic sparks that occur in fabric baghouses.
- Compliance with all atmospheric particulate emission standards.
- Improved thermal efficiency brought about by the ability to recover heat from a solid-free, high temperature gas stream. Gas quench or other cooling, which is typically required prior to a

baghouse or electrostatic precipitator, is not required with a GSS filter due to its superior temperature capabilities.

Products

Metals and Metal Oxides

Aluminum
Alumina
Magnesium
Titanium Dioxide
Metal Halides
Iron Powder
Iron Oxide

Catalysts

Zeolites
Alumina Supported
Metals and Oxides
Silica Supported
Metals and Oxides

Nuclear Fuel Cycle

Uranium Dioxide,
Uranium Tetrafluoride,
Nuclear Fuel
Reprocessing and
Vitrification.

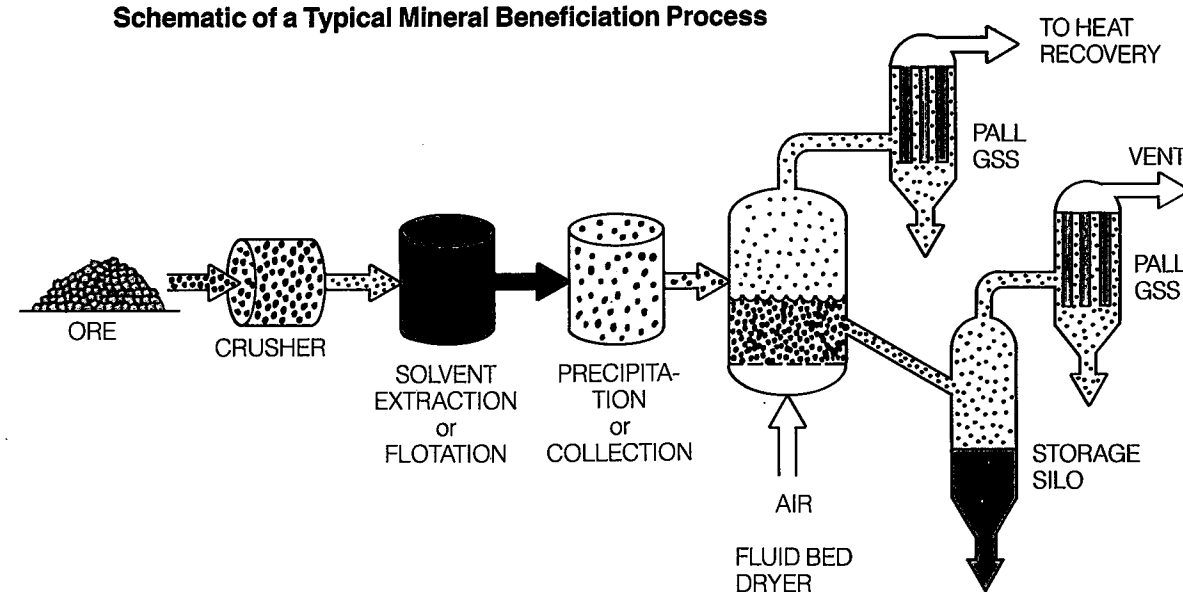
Silicon Products

Fumed Silica
Polycrystalline Silicon
Silicon Carbide

Alternate Energy Technologies

Coal Gasification
Coal Combustion
Shale Oil Conversion

Schematic of a Typical Mineral Beneficiation Process

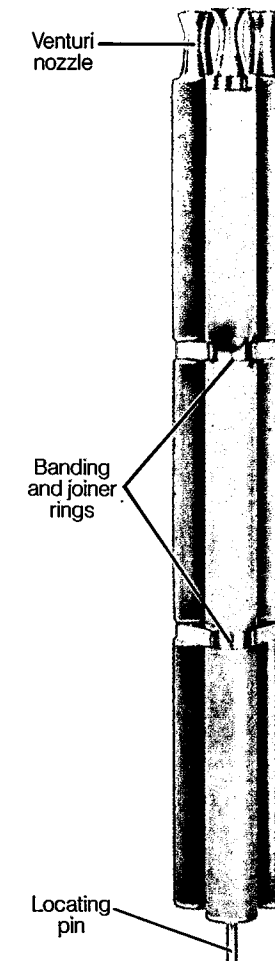


All welded construction

Elements are 80 inches in overall length, consisting of four 2 3/8 inch diameter sections, each 19 inches long. The sections are joined by welding solid joiner rings to the sintered metal tubes for maximum physical strength. Each element provides 4 ft² of filter area. All solid hardware is 304 stainless steel. The element is closed at one end by a welded end cap. A suitable adapter is welded to the open end for fitting to a tube sheet. Standard PSS medium thickness is 3/32 inches for the optimal combination of strength with low pressure drop characteristics. These standard elements can withstand pressure drops of 100 psid in both the forward and reverse flow directions.

Triad element design

In high temperature systems, typically above 800°F, elements are banded together in groups of three to form rugged triad clusters. The bands are welded to the solid joiner rings at 19 inch intervals between the PSS sections, to provide maximum stiffness and rigidity of the triads. The triad design ensures long, reliable service life in high temperature environments, and withstands the rigors of process upset conditions.



PSS Triad
element design

Tube sheet adapter

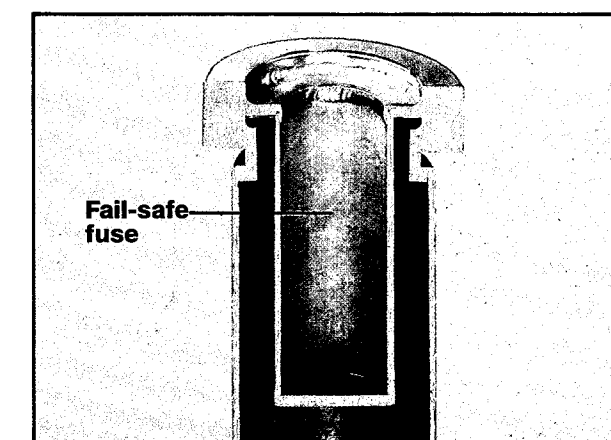
For systems using the jet pulse method of blow-back, a venturi is incorporated into the adapter. For systems using the reverse flow method, the adapter has a full bore open throat. (These methods are fully described in the next section.) The elements can either be welded or flanged to the tube sheet. The welded connection ensures no bypass of solids, and is typically used in critical high temperature applications. A flanged connector allows for simpler assembly and maintenance, and is suitable for lower temperature applications, typically below 800°F.

Support grid locating pins

Pins are welded to the blind end cap to locate the element in a support grid. Sufficient lateral and axial clearance is provided to accommodate thermal expansion and contraction of the elements during startup, normal operation and shut down. The support grid is an integral component of the filter assembly to provide sideways support and restrict element vibration during operation.

Fail-safe fuse

For critical applications where any particle bypass can have serious consequences, Pall's proprietary Fail-Safe Fuse is available as an option. The fuse is a small last chance filter within the primary filter element which permits continued operation without bypass of particles in the rare event of a filter element failure. The fuse is constructed of a coarse grade of PSS or Rigimesh medium, typically with a 20µm or coarser absolute removal rating, and usually of the same metal alloy as the primary element. It is designed for negligible pressure drop and is built to withstand even a failure of the primary filter element. The coarse grade medium quickly plugs with solids, resulting in an effective seal. For large systems, the loss of a single element in an assembly results in an insignificant increase in pressure drop or loss of capacity.



How the Pall GSS System Works

Pall Gas Solid Separation filter systems are designed to remove particulate matter from gas streams. To accomplish this, sintered powder metal filter medium with sufficiently small pores and sized at an appropriate flow rate per unit of filter area effectively retains solids at or near the filter surface. This results in the formation of a permeable cake of solids which is dislodged at a

predetermined pressure drop (a function of cake thickness and compressibility) by initiating a reverse flow. The dislodged solids are purged from the filter system, where they may be returned directly to the process for reuse or removed from the process stream and sent to a storage or collection unit. The filter is then returned to full forward flow and to a pressure drop which remains essentially constant through repeated blowback cycles. (Figures 1-3.)

Cake Formation and Release

FIGURE 1. HYPOTHETICAL CAKE STRUCTURE

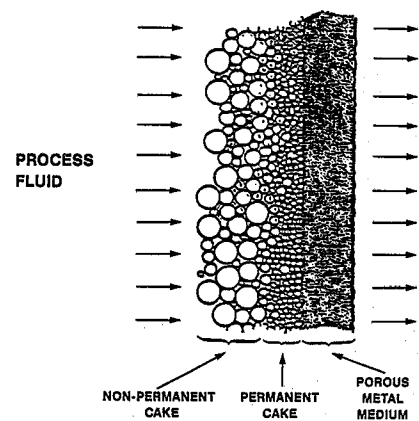


FIGURE 2. HYPOTHETICAL CAKE RELEASE

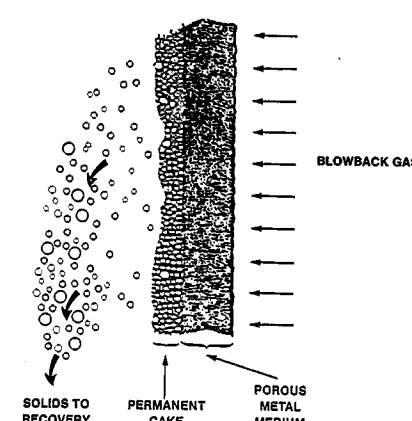
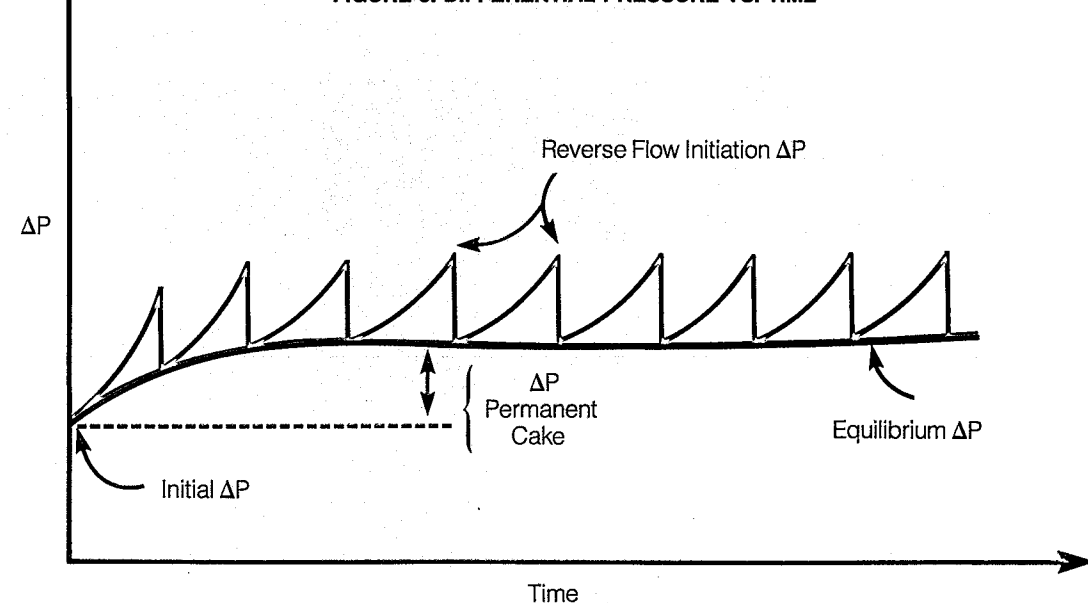


FIGURE 3. DIFFERENTIAL PRESSURE VS. TIME



GSS System filter recommendations

FCC Regenerator Flue Gas, third or fourth stage separator

Filter Medium

PSS grade H (absolute rating = $1.3 \mu\text{m}$) High temperature resistant alloy, such as Inconel 600.

Blowback Method

Jet pulse blowback, aided by downdraft design.

System Sizing

8-10ACFM gas/ft² filter area.

Control

Automated, pressure drop initiated blowback control.

FCC Catalyst Hopper Vent Filter

Filter Medium

PSS Grade H (absolute rating = $1.3 \mu\text{m}$) 316L stainless steel.

Blowback Method

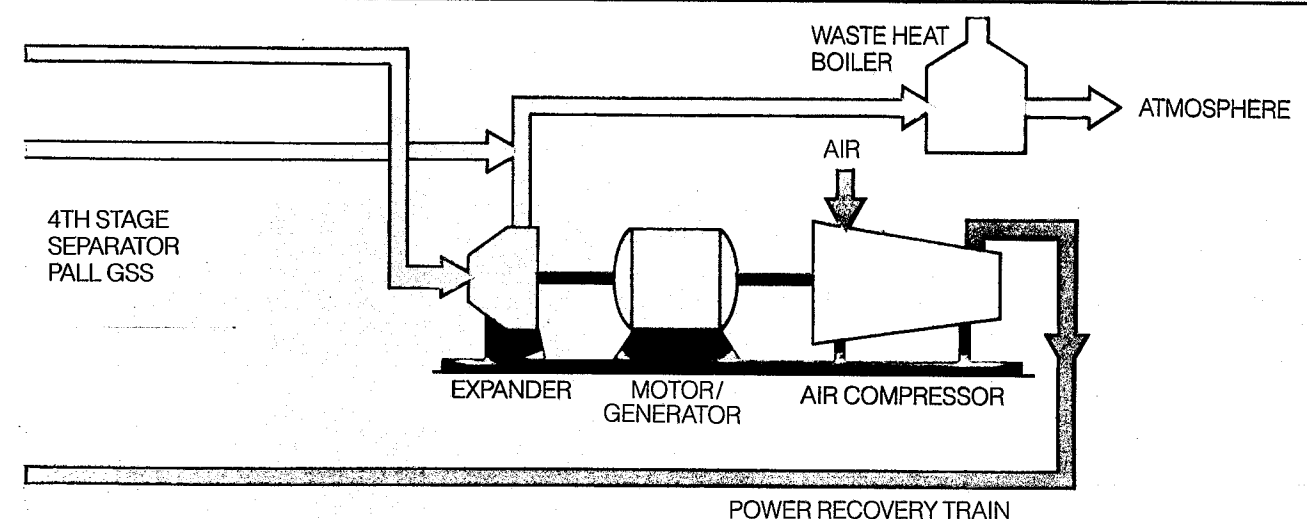
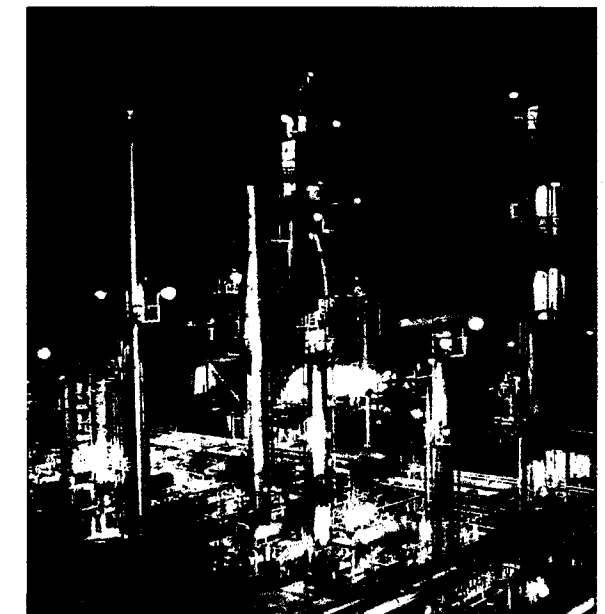
Reverse flow blowback with a single chamber vessel, to facilitate discharge of collected catalyst to the storage hoppers.

System Sizing

8-10ACFM gas/ft² filter area.

Control

Automated, pressure drop initiated blowback control.



OIL REFINING INDUSTRY

In the Fluid Catalytic Cracking process, there are several gas solid separation applications that can best be carried out by a Pall GSS System. The high separation efficiency and temperature capabilities of a GSS filter provide the following benefits:

- full compliance with the strictest Federal, State and local atmospheric particulate emissions standards.
- optimum protection of turbo expander and heat exchange equipment from the erosive and fouling nature of entrained catalyst fines in the FCC regenerator flue gas.

Benefits of Pall GSS System

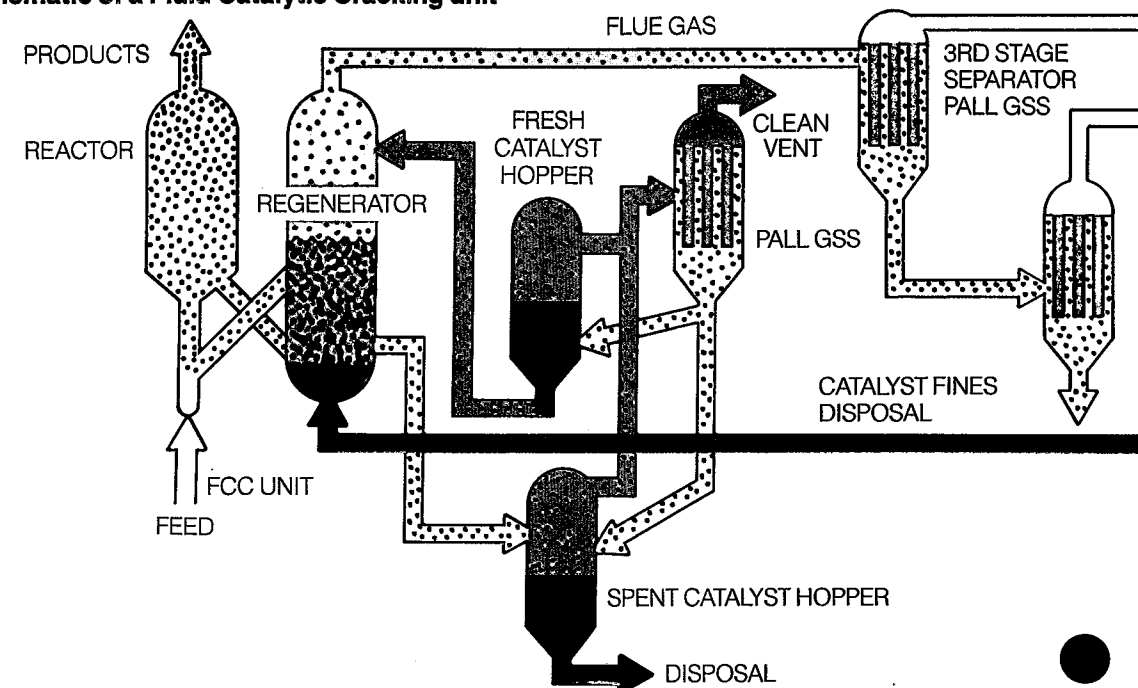
Replacement of the cyclone or baghouse typically used in the third stage underflow circuit (also called the fourth stage separator) significantly reduces the particulate emissions to the atmosphere. Typical cyclone efficiency in this service is 75%. By using a Pall GSS System in lieu of a cyclone, removal efficiency is increased to 99.99%,

resulting in a 30% reduction in particulate emission from the process. In many cases this will allow the refinery to meet the required emissions standards.

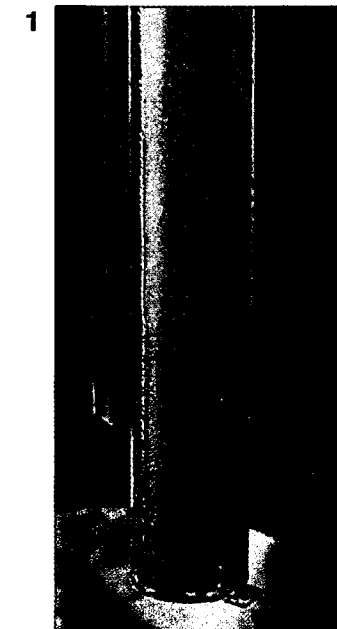
Alternatively, a retrofit of the multiple cyclones used in the third stage separator provides the best available protection of the turbo expander from erosion or fouling by catalyst fines. This increases the efficiency and reduces the maintenance requirements of the expander. It also protects the waste heat boiler from fouling, thus improving its thermal efficiency, and eliminates the need for an electrostatic precipitator or baghouse for final particle control prior to discharge to the atmosphere.

Use of a GSS System on the vent gas from the catalyst storage hoppers provides high efficiency and troublefree separation of catalyst fines during conveying operations. One GSS System installed on a common vent header virtually eliminates the catalyst loading and unloading operations as a source of particulate emissions.

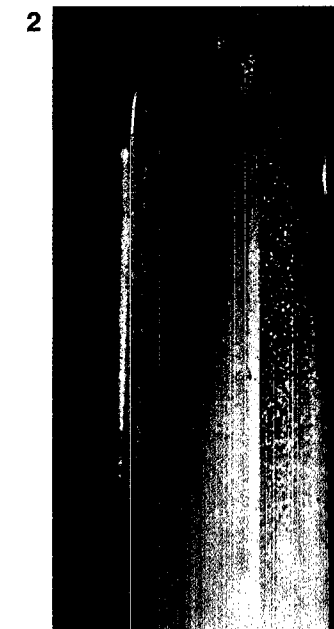
Schematic of a Fluid Catalytic Cracking unit



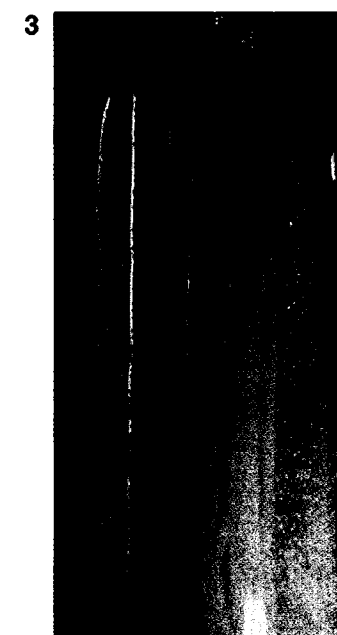
Sequence of Actual Cake Formation and Release



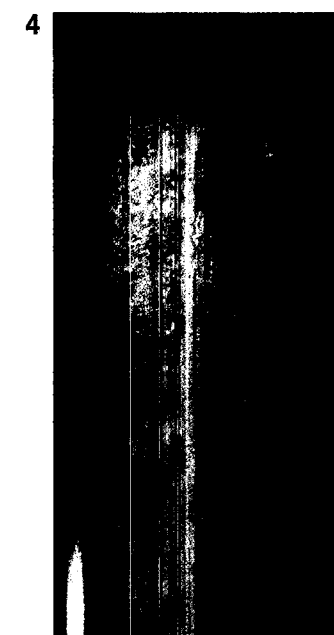
Pall porous metal filter element before use.



Element caked with fine solids prior to blowback.



Reverse flow effectively dislodges nonpermanent cake.



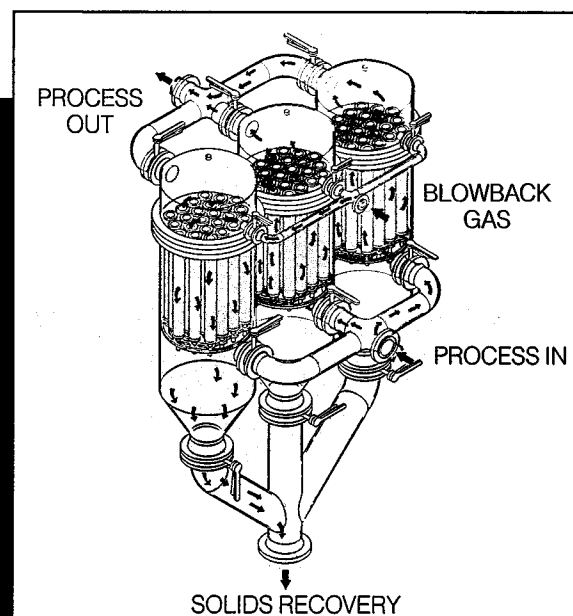
Element with permanent cake ready for resumption of forward flow.

THE PALL GAS SOLID SEPARATION SYSTEM

The Pall system design provides the optimal arrangement of GS Series filter elements into vessels, coupled with automated controls, instrumentation, valving and interconnecting piping. The GSS System is the technical and economical solution for high efficiency, reliability and safe separation of solids from process gas streams under the following conditions:

- high temperature: up to 1650°F
- vacuum to high system pressures: 0 to 1000psia
- high solids loading: in excess of 0.1 lb. solids/ft³ gas
- corrosive gas environments

Just as important as the selection of the optimum filter medium for GSS Systems is the selection of the most appropriate type and method of in situ element cleaning. The available designs are:



GSS System filter recommendations

Filter Medium

PSS grade F (absolute rating in gas = 2.8μm) for separating catalyst with a size range of 20μm and larger. PSS grade H (absolute rating in gas = 1.3μm) for separating catalyst with a size range of 1μm and larger.

Blowback method

The jet pulse method is used for the most effective catalyst recovery and long term service. The Downdraft design is used for very fine and light catalyst, with bulk densities under 20 lb/ft³ and temperatures above 800°F.

Filter Medium Alloy

The standard alloy is stainless steel 316L series, and is typically used up to 600°F in oxidizing atmospheres and 1300°F in reducing atmospheres. For higher temperatures or other corrosive environments, 310 stainless steel, Monel, Inconel, nickel or other corrosion resistant alloys are provided.

System Sizing

8-10ACFM gas/ft² filter area.

Control

Fully automated, pressure drop initiated blowback, using quick acting valves to control the blowback gas pulses.



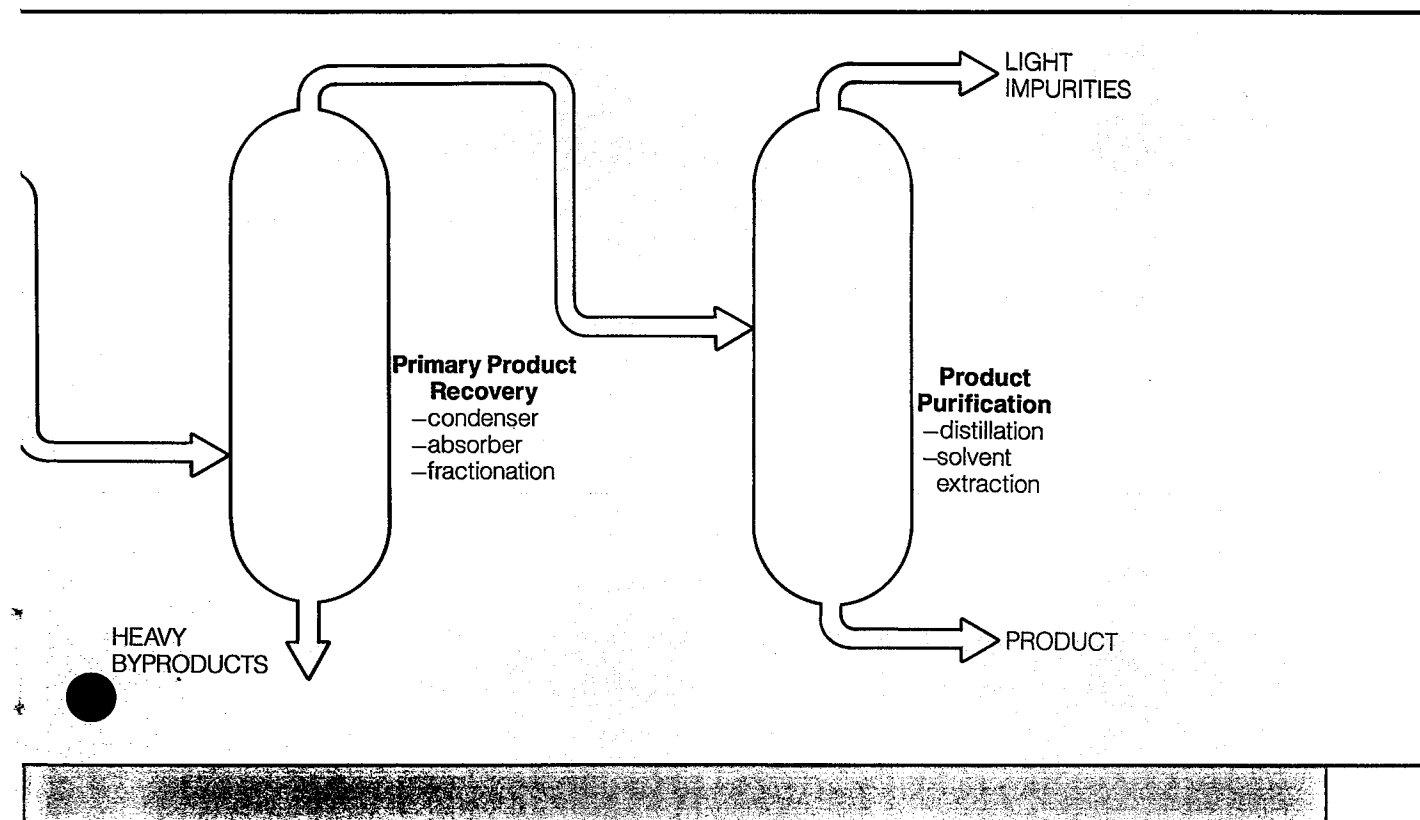
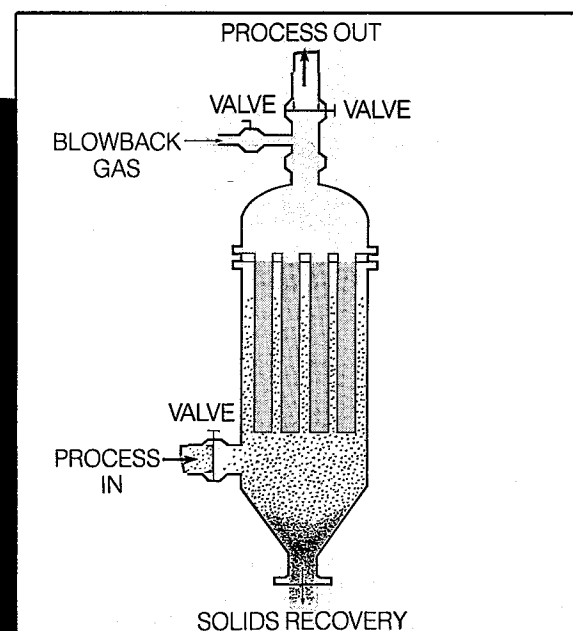
GSS assemblies for catalyst recovery from a fluid bed reactor process, showing triad element construction.

Reverse flow blowback

GSS Systems with reverse flow blowback use one or more vessels for continuous process flow. To clean the filter elements when the terminal pressure drop is reached, one vessel, or compartment within a vessel, is isolated by closing the inlet and outlet valves.

A reverse flow of blowback gas is directed through the elements at 50 to 70% of the forward flow rate for two to four seconds. This removes the accumulated cake of solids from the elements. The quantity of blowback gas consumed is typically equal to the volume of the chamber in which the elements are contained. These filter elements are then brought back on line. The cycle continues with the sequential blowback of the remaining vessels or compartments.

The reverse flow method is selected for solids with a bulk density of less than 20 lb/ft³. Such light solids do not settle quickly by gravity and require the assistance of a reverse flow of gas to prevent re-entrainment onto the filter elements once forward flow resumes.



CHEMICAL PROCESS INDUSTRIES

Fluid Bed Reactor processes are widely used in the Chemical Process Industry. The fine powdered catalysts are costly, and are typically recovered from the reactor effluent stream by multiple stages of cyclones. The solid separation efficiency of a Pall GSS System is at least 99.99%, compared with about 99% for a multi-stage cyclone system. This means a one hundred times reduction in catalyst losses, which typically pays back the cost of the GSS System in under one year.

Typical products produced in fluid bed reactors

Phthalic anhydride	Isophthalonitrile
Maleic anhydride	Vinyl chloride
Acrylonitrile	Methanol to Gasoline
Fischer Tropsch Synthesis	

Benefits of Pall GSS System over traditional equipment

- compared with cyclones, a one hundred fold reduction in the loss of expensive catalyst which provides a short pay back period and helps maintain catalyst activity by recycling catalyst fines to the reactor.
- dipleg plugging and trickle valve erosion and by-passing—problems inherent in cyclones—are eliminated, increasing reactor reliability and reducing maintenance requirements.
- reactor throughput can be increased without incurring an increase in catalyst losses.
- downstream product recovery and purification equipment is protected from entrained solids that cause fouling, plugging and erosion of equipment components.

Jet pulse blowback

The jet pulse method also uses one or more vessels. Full forward flow is maintained at all times, eliminating the need for large vessel isolation valves. Groups of elements are blown back sequentially by directing a high pressure pulse of gas into the throat of each element. The pulses are of 0.1 to 1.0 second duration and at 2-3 times the process pressure. During this period, the flow to the elements being cleaned is reversed momentarily by a high pressure jet pulse. The shock wave set up by the reverse pulse, enhanced by the venturi in the element throat, effectively removes the accumulated cake from the elements.

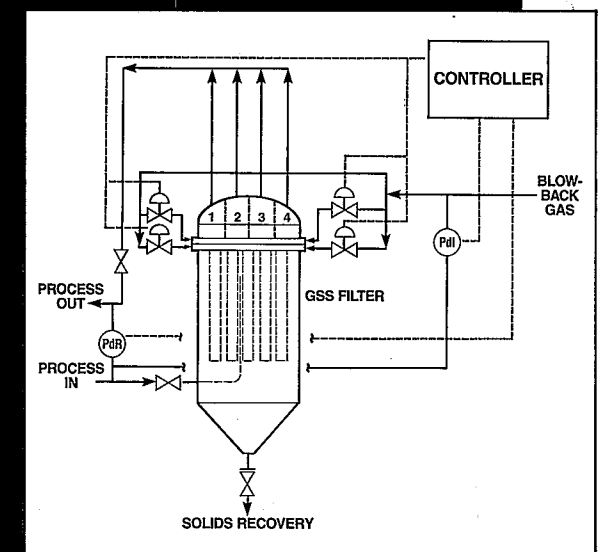
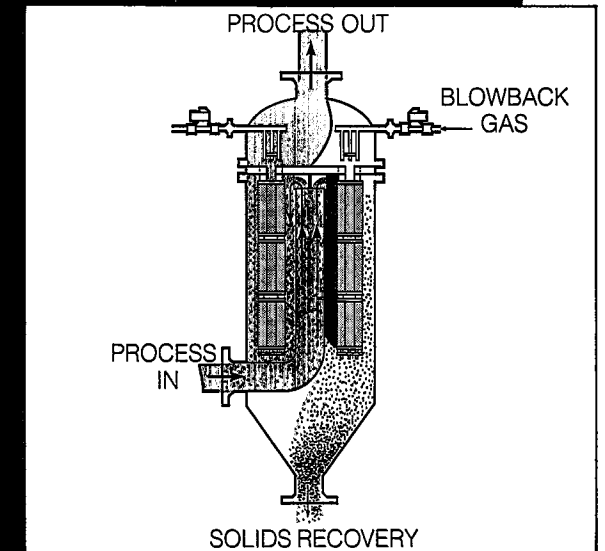
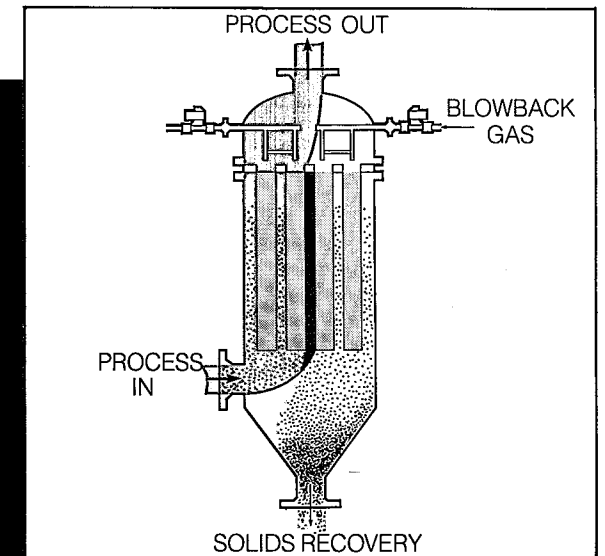
Jet pulse blowback is selected for solids with a bulk density greater than 20 lb/ft³ which will settle rapidly after being dislodged from the filter elements. This eliminates the need for isolation valves and results in significant cost savings, especially in high temperature applications.

Downdraft design

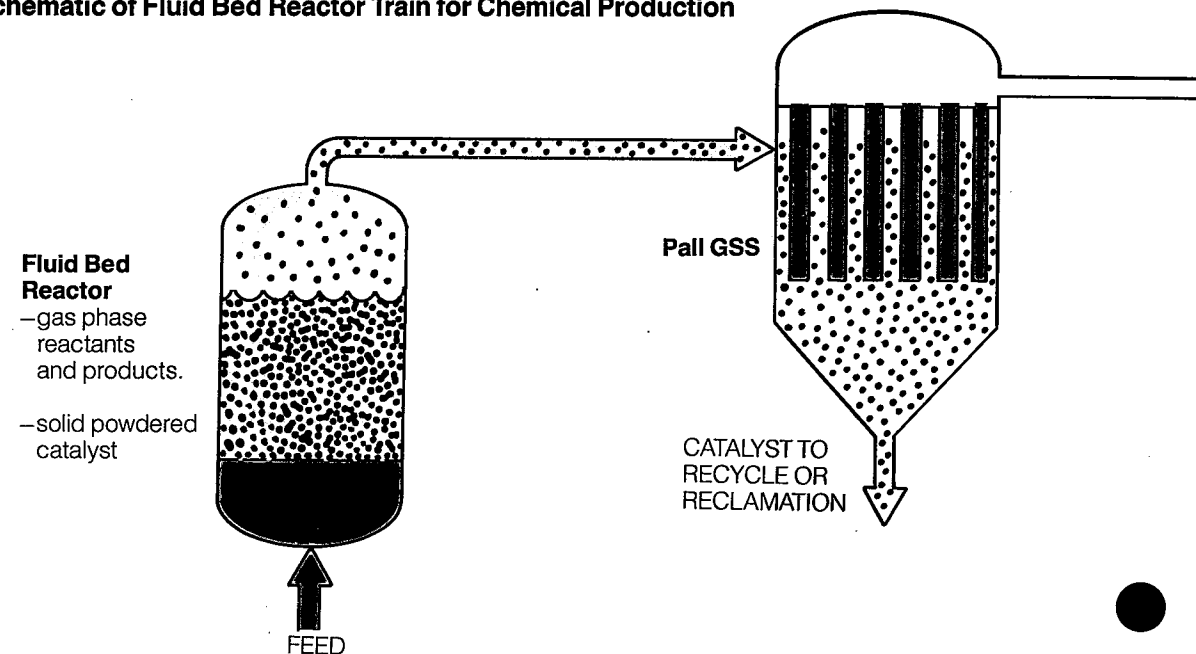
In high temperature applications, typically above 800°F, the large isolation valves required for reverse flow cleaning become extremely costly, and the jet pulse method is preferred. When light solids with a bulk density below 20 lb/ft³ are to be separated under these conditions, the Downdraft option is used. This consists of a central pipe extending upwards from the contaminated gas inlet to below the tubesheet. The net gas flow around the elements is therefore in the downward direction, assisting released solids in settling to the bottom of the vessel.

Control methods

Any of these methods can be initiated manually or automatically, on either a fixed time cycle or by differential pressure actuation. For continuous flow systems, automated operation is recommended. Initiation by filter pressure drop automatically compensates for fluctuations in solids loading by always blowing back at the same predetermined pressure drop. Initiation by a timer provides a constant consumption of blowback gas.



Schematic of Fluid Bed Reactor Train for Chemical Production



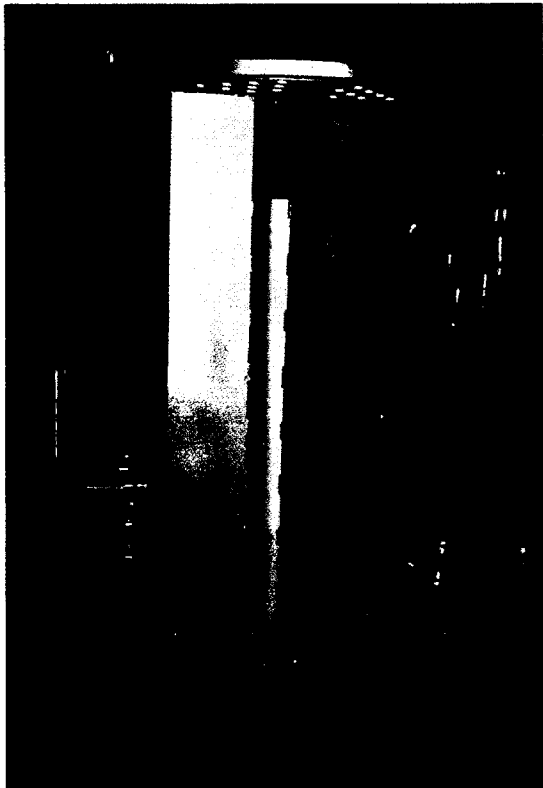
Applications of
Pall GSS systems

Pall GSS Systems can either be used as new installations or to retrofit existing conventional equip-

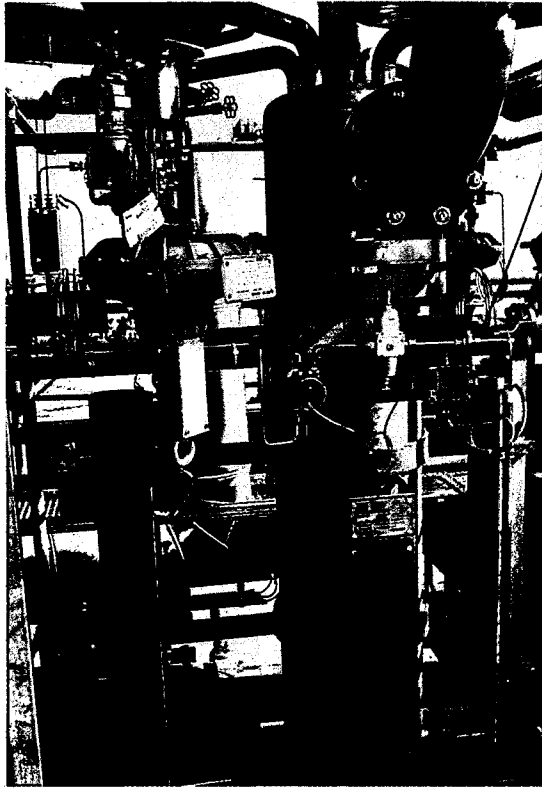
ment, such as cyclones, baghouses, scrubbers, and electrostatic precipitators. The superior capabilities of Pall GSS Systems over other types of equipment are as follows:

	Pall GSS	Cyclone	Baghouse	Scrubber	Electrostatic Precipitator
Efficiency of solid separation from gas stream	>99.99%	98%	99.9%	99%	99%
Maximum operating temperature	1650°F	>2000°F	450°F	450°F	900°F
Relative operating pressure drop	Medium	Medium	Medium	High	Low
Separation efficiency sensitivity to solid loading	No	Yes	No	Yes	Yes
Sensitivity to changes in flow rate	Insensitive	Very Sensitive	Some Sensitivity	Very Sensitive	Very Sensitive
Pre-cooling required upstream of solid separation device	No	No	Yes	Yes	Yes
Solid loading reduction prior to final separation required	No	No	Yes	Yes	Yes
Reliability and safety of operation	High	High	Low	Medium	Medium

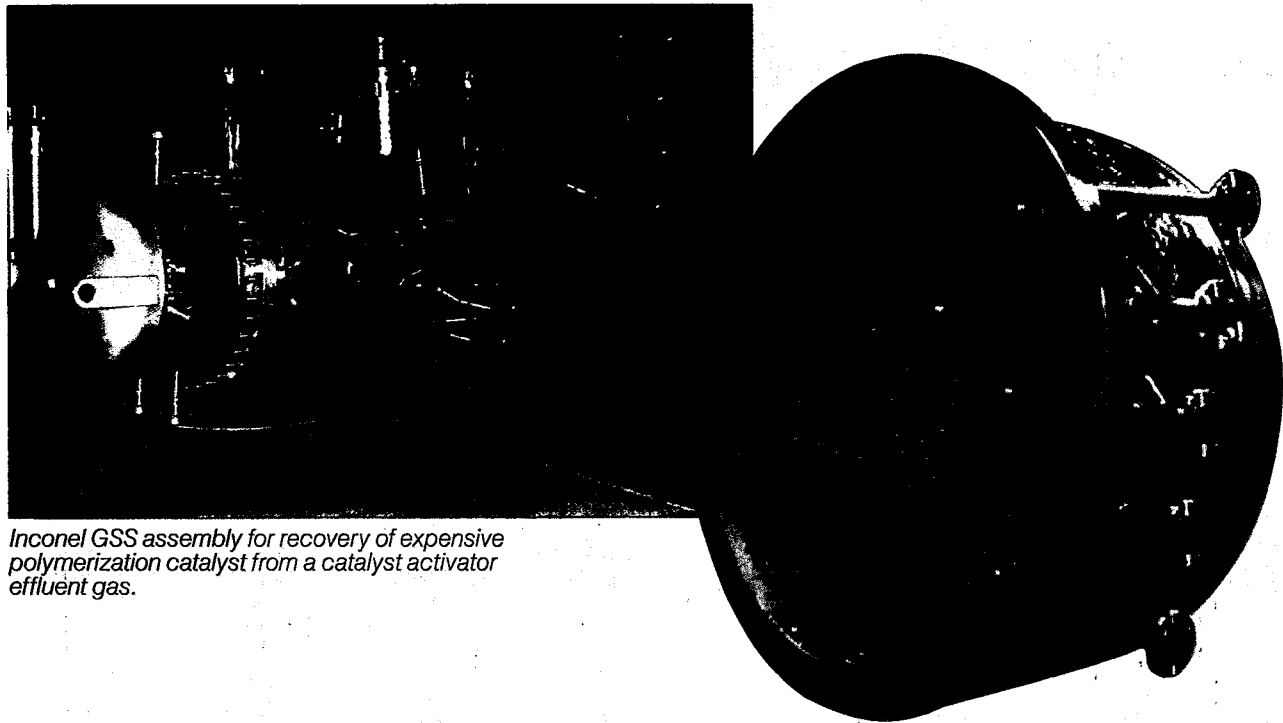
Pall GSS Systems are capable of meeting the strictest EPA New Source Performance Standards for particulate emissions. This is a maximum emission level of 0.022 grain/dry SCF (50 mg/dry SCM) for most particulate sources in the chemical process, minerals and refining industries.



Downdraft design assembly, showing central pipe and baffles to separate quadrants.



GSS system using jet pulse blowback in a synthetic fuels pilot plant.



Inconel GSS assembly for recovery of expensive polymerization catalyst from a catalyst activator effluent gas.

Vessel head assembly, for collection of polypropylene granules, showing jet pulse blowback nozzles.