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Addressed to: KENT MORTON Fax No. 403) 273-2980
 Company: GIANT YELLOWKNIFE MINES
 City: YELLOWKNIFE Province or State: NWT Country: _____
 Number of Pages: 12 Price: _____
 (Including Cover)

Instructions/Message: RE: CYML WAROK PROJECT
POROUS METAL FILTERS

ATTACHED PLEASE FIND PROPOSAL FROM PALL
ON POROUS METAL FILTERS FOR THE ABOVE PROJECT.

THIS INFO WAS REQUESTED FROM PALL IN EARLY DEC '88
AND HAS JUST BEEN RECEIVED.

REGARDS,



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January 11, 1989

Fenco
2235 Sheppard Ave. East.
Willowdale, Ontario
M2J 5A6

Attention: Mr. Nick Figgess

SUBJECT: PALL POROUS METAL (PSS) BLOWBACK FILTERS FOR
WAROX PROJECT AT GIANT YELLOWKNIFE MINES LTD.

Pall Budget Proposal # B7BB77L184

Dear Nick,

On behalf of Dave Howson (our area technical sales representative), Rene Shanks (our AEC Marketing Specialist), and myself, Pall (Canada) Ltd. is pleased to provide the following budget proposal for a Pall PSS Blowback Assembly to suit the needs of your client for the referenced high temperature filter application.

After careful review the basic application parameters, as "faxed" to us on Dec. 8, 1989, we believe a Pall Porous Metal filter can be well tailored to this application utilizing existing Pall Filter technology found in similar, high flow applications throughout the world.

Background

The application of Pall sintered metal filter assemblies to remove particulate from high temperature gas streams has been practiced for over 30 years. We have built virtually hundreds of units for self-cleaning blowback applications and wish to utilize this experience and work with you on this very important Roaster Exhaust Gas project.

Blowback Filter Design Criteria

In order to achieve a successful installation, Pall Corporation has learned that the design of porous metal blowback filters is based on the following criteria:

continued

CORPORATE AFFILIATES

Pall Trinity Micro Corporation, Cortland
Pall Europe Ltd., Portsmouth, England

APM, St. Petersburg, Fla.
Pall Corporation, Glen Cove, N.Y.

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1. Cleanability- Capable of being efficiently blown back while in service, to provide repeatable self-cleaning cycles once an equilibrium pressure drop is achieved.
2. Efficiency- Must be able to remove 100% of (extremely fine) particulate.
3. Media- Must be such that surface texture is compatible with particulate.
4. Uniformity- Pore structure should be fairly uniform to insure even filtration and blowback over the entire filter surface.
5. Fabricated element strength- Able to withstand the mechanical and thermal stress of the application.
6. Alloy- Proper alloy relative to the specific environment.
7. Element Configuration -Proper element spacing, and relationship to housing and hardware with the proper diameter versus length ratio.
8. Assembly Design- Proper housing configuration and tube sheet/element bundle-support design. Housing/element relationship must be considered.
9. Particulate- Should identify Solids loading, as well as nature and size distribution of particulate.
10. Cycle Time- Proper blowback cycle technique and dewpoint considerations.
11. Housing configuration -For proper flow profile and solids deposition.

Once the above criteria is established, our engineering and SLS personnel study the information, enabling us to design an optimum blowback filter.

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Design Conditions Considered

Gas Flow Rate:	1785 ACFM
Gas Temperature:	750 F
Process Line Pressure:	To be determined
Process Line Size:	10 inch
Dirt Load:	75 grams/ACF
Particle Size Distribution:	100% less than 10 microns

Particle Composition : Iron Oxides
Insoluble Compounds
Arsenic Trioxide
Antimony

Gas Composition:	Water Vapour	6%	by volume
	Carbon Dioxide	4%	
	Arsenic Trioxide	8%	
	Nitrogen	79%	
	Oxygen	2%	

FILTER ASSEMBLY DESIGN

For this application, we propose our automated Jet Pulse Blowback filter concept (see Pall product bulletin GSS-V3 attached for an general design description). This technique utilizes downward vectorial force created by the movement of inlet gas flow, to assist in particulate collection during filter element blowback cycle after the fluid particulate has been separated and terminal pressure drop has been reached across the filter media. The approach is well suited to applications of higher flow densities where the process contaminant is fine and low in bulk density.

Our preliminary sizing indicates that our system would comprise one 38 inch O.D. vessel of carbon steel construction, with 10 inch inlet and outlet connections and a conical shaped vessel bottom to accommodate for solid discharge. The vessel would house a total of approximately ninety six (96) 95 inch long by 2 3/8 inch O.D. Pall Porous Metal S-Series filter elements having an absolute removal rating of 5 microns. The elements have a Venturi style nozzle configuration, and are welded into a removable tube sheet assembly.

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The element would utilize 304 SS solids and 316 SS porous metal materials.

An automated, programmable controller would provide the automation for the high temperature quick action butterfly valves used in the blowback system.

Total Filter Assembly Budget Price: \$250,000CDN

Technical Comments

Our basis for the design of this system (i.e. removal efficiency and flow density / sq. ft. of porous metal media) is a result of numerous discussions with Mr. Ross Gilders of the Research and Productivity Council (RPC) in New Brunswick. However, our 40 years of experience with Porous Metal technology leaves us with some design concerns regarding blowback technique and optimum flow density. For these reasons, we strongly suggest a meeting of our Scientific and Laboratory Services (SLS) personnel, those of GYM/RPC and/or Fenco at your earliest possible convenience.

As per our experience we can also comment on the following:

1. A minimum of a 30 SCFM at a 60 PSIG blowback gas supply would be required to provide the pulse gas necessary for the blowback function.
2. With regards to interrupted flow operation, in order to avoid problems associated with damp filter cake and vessel and element corrosion, the assembly would have to be maintained at a temperature above the lowest possible process gas dewpoint with a margin of safety to be determined after evaluation of the application particulate. We can only assume that a bleed of process gas would be incorporated to satisfy this requirement. Alternately a side stream heating method may also be the most practical choice.
3. Insulation of the assembly, vessel support structure, conduit to the control panel, and solids recovery handling equipment, are not included in our pricing or supply scope.

continued

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Dimensions- For study purposes please refer to Bulletin GSS-V3 which provides a basic overview of the dimensions of the assembly quoted.

Delivery can be estimated at 14 to 16 weeks from receipt of formal approval to manufacture from the purchaser to Pall (Canada) Ltd.

Terms Unless otherwise negotiated, Net 30 days F.O.B. Mississauga, Ontario.

Pall Scientific Laboratory Services (SLS)

Laboratory Testing

Performing a simulated test, either at our SLS facility in Glen Cove, New York, or at your plant will be necessary to the establishment of optimum design criteria.

Testing in our lab facilities is provided to the customer on a nocharge basis.

The lab analysis will include:

1. Identification of the sample(s) particle size distribution.
2. Total particulate fluidization in a test filter rig, at several flow densities to establish the interface characteristics of the contaminant and several grades of our filter media.
3. Actual scale cycling in the test rig, to establish filter media in-situ cleanability for a representative period of time. (Generally in excess of 2000 cycles).
4. Media compatibility with all operation conditions.

We understand that the particulate involved is considered toxic and may limit our test efforts at our corporate facilities. We feel that a logical option would be to have our SLS personnel visit RPC to assist with the design testing.

continued

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We welcome yourself and other members of your firm to witness these tests in our facilities once the basic design criteria has been established.

Field Testing

A representative scale field side stream test at your facility will also provide valuable performance data of our filters in your application.

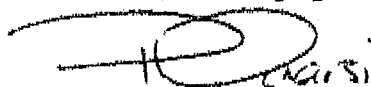
SLS assistance will also be made available at no-charge, to help set-up, run and collect performance data necessary for your purchase evaluation.

Successful Installation Reference

To further demonstrate the capabilities of Pall PSS blowback filters, we attach a selection of Filter installations for your review. The same design approach as per the above resulted in the effective operation of the systems at these locations.

We trust that the information provided is to your company's satisfaction and certainly look forward to the opportunity to work with you on this project. Should you have any questions or require additional information, please do not hesitate to contact us.

Very truly yours,



Paul Vaarsi
Applications Engineer

CC: B. McLeod
R. Shanks
B. Ferneyhough
P. Vaarsi
N. Cathcart



GSS FILTER VESSELS DOWNDRAFT JET PULSE DESIGN

1-88-V3
November 1987

Description

Pall downdraft jet pulse design vessels are fitted with the GS series of PSS® sintered metal powder elements. Blowback is accomplished by directing a short duration pulse of high pressure gas into the throat of each element, while maintaining full forward flow. The central pipe induces a downward flow of gas around the elements to assist the settling and discharge of light solids (bulk density less than 20 lb/ft³).

The vessels are available in carbon steel, 304 stainless steel, or other alloys as required. Standard designs offer a maximum pressure of 600 psig at 400°F and a maximum temperature of 1400°F at 100 psig (see Table 1). Higher design limits are available. Other options include refractory linings for high temperature insulation, jacketed vessels for precise temperature control, and fluidizing cones to assist solids discharge. External mounting lugs are provided as standard. All vessels are designed for ASME Section VIII, Division 1 and "U" stamped. The system includes all instrumentation and solenoid valves to control blowback operation.

The vessel head is bolted to the vessel, capturing the tube sheet and elements between the vessel body flanges. This allows for easy access and removal of the elements should service be necessary. The gas inlet connects with the central pipe to create the downward flow direction around the elements. A cone angle of 30° is standard to facilitate solids discharge.

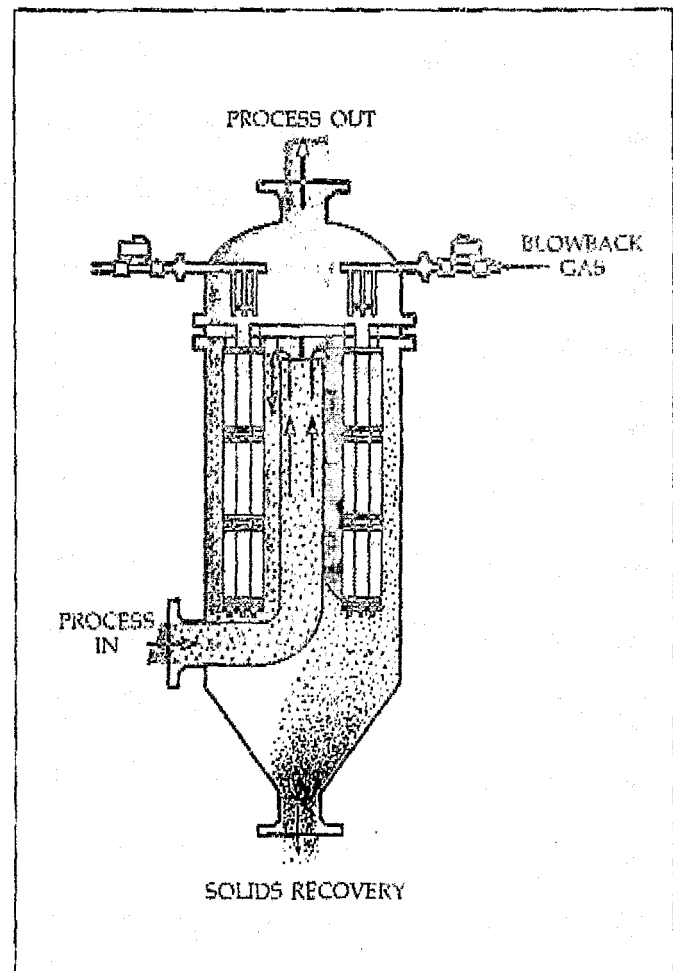


Figure 1. Downdraft Jet Pulse Schematic

Table 1. Vessel Specification

Carbon Steel				Stainless Steel			
Type	Flanges	Pressure (PSIG)	Temp (°F)	Type	Flanges	Pressure (PSIG)	Temp (°F)
Low Pressure	150 lb.	50	750	Low Pressure	300 lb.	10	1400
		60	650		150 lb.	50 60	900 400
High Pressure	600 lb.	500	750	High Pressure	600 lb.	100	1400
		600	650			500 600	900 400

Table 2. Filter Characteristics

Number of GS Elements	Area Ft. ²	Vessel Diameter (Inches)	Vessel Length (Inches)	Inlet/Outlet Nozzles (Inches)	Drain Nozzles (Inches)	Dimension A (Inches)	Dimension B (Inches)	Differential Pressure Loss Factor K_v
5	20	12	100	3	3	92	10	1.9×10^{-4}
10	40	16	110	4	4	98	14	5.1×10^{-5}
19	76	22	120	6	6	105	19	1.3×10^{-5}
31	124	26	128	8	6	108	20	4.6×10^{-6}
42	168	28	132	10	8	112	22	2.4×10^{-6}
68	272	36	140	12	8	116	24	9.5×10^{-7}
96	384	42	152	14	10	126	28	5.0×10^{-7}
130	520	46	164	18	10	138	36	2.5×10^{-7}
170	680	54	176	20	12	148	42	1.5×10^{-7}

Table 3. Approximate Vessel Weights (lbs.)

Vessel Diameter (Inches)	Carbon Steel (Weight)		304 SST (Weight)	
	Low Pressure	High Pressure	Low Pressure	High Pressure
12	650	1300	575	1275
16	950	2050	850	2050
22	1750	3650	1550	3900
26	1850	5100	1850	5400
28	2100	8350	2100	8350
36	3350	9000	3350	9000
42	4700	12350	4700	12350
46	5650	15600	5650	15600
54	7450	23700	7450	23700

Pressure Drop Calculations

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 2.

 K_m values are:

PSS Grade	K_m (for 3/32" medium thickness)
PH	2.0
PF	0.45

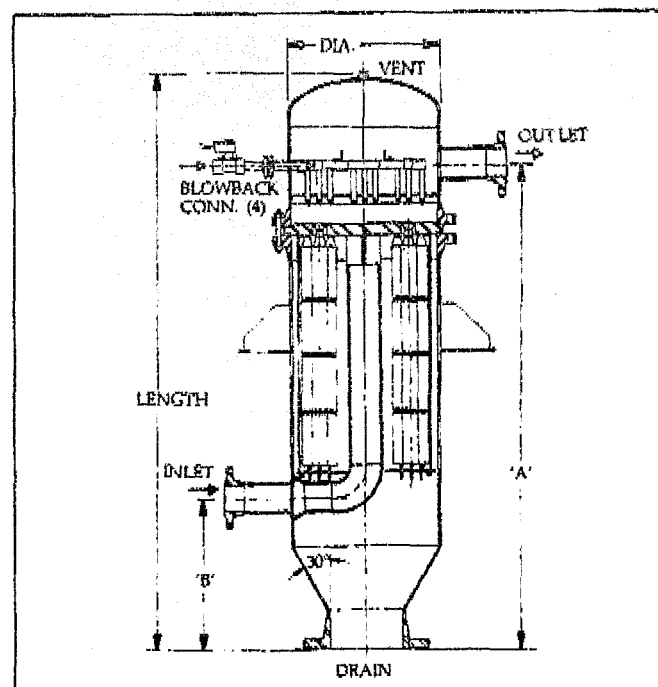


Figure 2. Dimensional Drawing of a Standard Downtraft Design Vessel



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Serves the Refinery, Natural Gas, Petrochemical, Polymer, Chemical Process, Minerals, Electric Power, Pharmaceutical, Electronics, and Food and Beverage Industries.

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PSS BLOWBACK FILTER APPLICATIONS

<u>COMPANY</u>	<u>LOCATION</u>	<u>APPLICATION</u>
AB Chemicals	Deer Park, TX	Catalyst Recovery
Allied Chemicals	Metropolis, IL	Reductor, hydrofluorinator, and fluorinator off gas treatment
American Cyanamid	Willow Island, WV	Catalyst Recovery Aniline
Amoco	Naperville, IL	FCC semi-works plant. Filters are downstream of cyclones and above catalyst regenerator
Argonne National Laboratories	Argonne, IL	Nuclear Fuel Cycle R&D
Badger	Cambridge, MA	Catalyst removal in various fluid bed technologies
Badger/Sasol	South Africa	Pilot Plant
Battelle Northwest Laboratories	Richland, WA	Remove transuranic element oxides from spray calciner
C-E Nuclear	Hematite, MO	Uranium recovery from converter off gas in DC Process for nuclear fuel in fabrication
Chemplex	Rolling Meadows, IL	Catalyst Recovery
Chevron	San Francisco, CA	Fly Ash- Shale Oil
City Service	Houston, TX	Pilot Plant
Dart Industries	Odessa, TX	Catalyst Recovery
Diamond Shamrock	Greens Bayou, TX	Catalyst fines from fluid bed reactor and regenerator
E.I. duPont deNemours	Orange, TX Victoria, TX	Catalyst Recovery Polyethylene
E.I. duPont deNemours Savannah River Lab	Aiken, SC	Remove transuranic element oxides from spray calciner offgas

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<u>COMPANY</u>	<u>LOCATION</u>	<u>APPLICATION</u>
Fluor/Aljubar	Irvine, CA	Polyethylene
G.E. Waterford	Waterford, NY	Polycrystalline-fumed silica
Goodyear Atomic	Piketon, OH	Pneumatic system filter in enrichment plant
Gulf Oil Corp.	Orange, TX	Catalyst Recovery Polyethylene
Gulf Oil Corp.	Pitt., PA	Fly Ash- Shale Oil
Kerr-McGee	Gore, OK	Fluorinator offgas treatment in wet process conversion plant
Koch	Windsor, CN	Venturi Blowback Fluid bed volume reduction
Koppers Company	Bridgeville, PA	Phthalic anhydride process catalyst recovery
Los Alamos	Los Alamos, NM	Low level radwaste incinerator offgas treatment
McCartney Mfg. Co.	Baxter Springs, KS	Low density polyethylene production
Northern Petro Chem	Morris, IL	Polypropylene
SASOL	South Africa	Catalyst recovery from reactor regenerator offgas in synthetic fuel plant
Science Applications Incorporated	LaHolla, CA	R&D for offgas treatment system of slagging pyrolysis radwaste incinerator
Soltex Polymer	Deer Park, TX	Catalyst reactivator filter
Texas Instruments	Dallas, TX	Proprietary fluid bed reactor offgas system
Union Carbide	Paducah, KY Oak Ridge, TN	Pneumatic system filters in enrichment plants Offgas in nuclear fuel reprocessing pilot plant

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<u>COMPANY</u>	<u>LOCATION</u>	<u>APPLICATION</u>
Union Carbide	Seadrift, TX Sarnia, Ontario Sweden	Remove catalyst fines from polyethylene reactor product discharge tanks
USI Chemicals	Tuscola, IL Deer Park, TX	Catalyst recovery
Westinghouse	Columbia, SC	Vent filter, Nuclear fuel