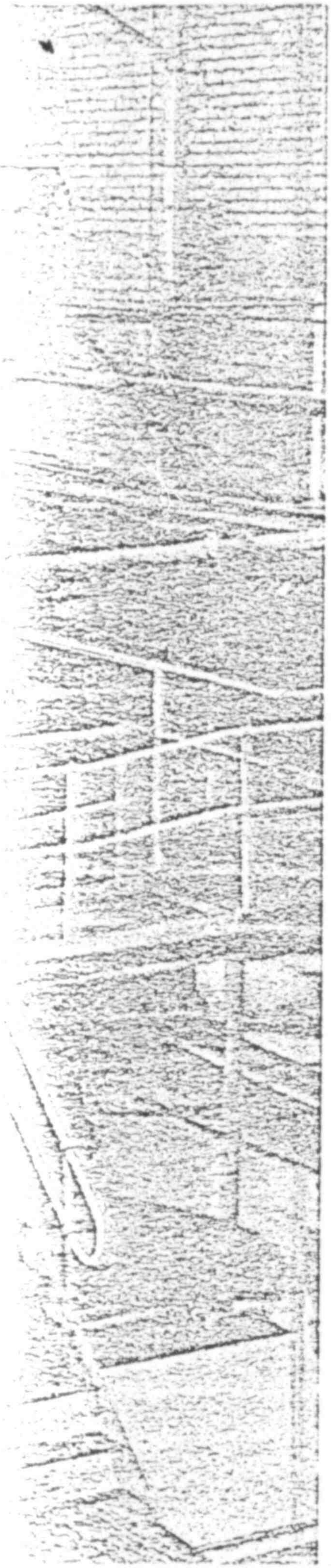

M-25
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K-5 #5

THE ENVIRO-CLEAR DELKOR HORIZONTAL BELT VACUUM FILTER

CONTENTS

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Enviro-Clear A DIVISION OF Amstar CORPORATION
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SOMERVILLE, N.J. 08876
201 526-5454 TWX710-480-9233

THE ENVIRO-CLEAR/ DELKOR HORIZONTAL BELT VACUUM FILTER

ADVANTAGES

1. HIGH THROUGHPUT AND MINIMUM CYCLE TIME

The design of the Delkor filter ensures maximum utilization of the filter area and resultant high efficiency. Typically, a Delkor filter will require one third to one half of the area requirements of a rotary vacuum filter and will operate at a higher wash efficiency.

The ability to operate with very thin cakes allows the filtration cycle time to be minimized and even on a 1000 ft² filter, the minimum cycle time is one minute, giving at least a 40% increase in throughput compared to other horizontal filters and an even greater increase in throughput compared to rotary vacuum filters.

2. LOW INVESTMENT AND MAINTENANCE COST

Because of the simple design and high throughput of the Delkor filter, it is directly comparable in cost with even mild steel rotary vacuum filters. The unique design of the Delkor filter allows for larger filtering areas in a single unit, up to 2150 ft². Building, installation and maintenance costs are lower than for rotary vacuum filters.

Prices are much lower than those of any other vacuum filter for applications where mild steel is not suitable for parts in contact with the fluid.

The rugged construction and simple design, which minimizes friction, results in very low maintenance and operating costs. Cloth life is particularly good due to the thorough washing. Filter cloths do not require expensive edging materials. Maintenance is simplified due to the easy access to all filter parts.

3. NATURAL PRECOAT EFFECT

As the feed slurry to the filter is distributed onto the moving belt, some segregation of particles by size occurs. The coarser particles settle rapidly forming a precoat on the filter cloth, thus improving the quality of the filtrate by reducing the quantity of fine particles passing through the filter cloth, an effect that cannot be achieved on rotary vacuum filters.

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4. HIGHLY EFFICIENT WASHING

The almost theoretical displacement of mother liquor in the cake in addition to the virtual absence of cross flow from one zone to another, gives maximum wash efficiency with a minimum wash liquor volume. The high wash efficiency gives a very high cake purity and minimizes effluent problems. Premature cake cracking can be readily eliminated by changes in wash liquor rate or point of application.

5. COUNTER CURRENT WASHING

Counter current washing can be used to minimize the amount of wash liquor. In this system, the clean wash liquid is fed onto the discharge end of the cake, and the wash liquor, from this first wash, is used to wash the cake nearer the slurry feed point, and so on.

6. FLEXIBILITY OF OPERATION

A 6 to 1 variable speed drive unit is standard and this together with the ability to vary the slurry feed rate, cake thickness, wash liquor rate and vacuum permits ideal operating conditions to be selected during actual operation.

It is also possible to move the positions of the dams, which fix the different wash zones, and the washing troughs. The vacuum box is provided with a number of filtrate removal connections so that the most suitably placed connections, in conjunction with moveable dams inside the vacuum box, can be used for withdrawal of the various wash and product filtrates.

7. EASE OF CLEANING

In the small filters, the vacuum box can be opened manually or pneumatically to give easy access for cleaning and inspection.

On the large filters, fitted with two, three or four transporter belts, the vacuum boxes are lowered hydraulically, all of the boxes being lowered at the same time.

The easy access to the vacuum box, and the fact that all the other filter parts in contact with the liquid are washed clean continuously during normal filter operation, makes cleaning very simple. Routine cleaning of the vacuum box is only necessary with liquids which form scale, such as phosphoric acid.

8. HIGHLY RESISTANT TO CORROSION

The vacuum box does not move during operation of the filter and is specially designed for easy fabrication. It can be supplied in a number of materials, including stainless steel, monel, titanium, PVC, glass reinforced epoxy or other materials of construction.

The transporter belts can be supplied in a variety of natural and synthetic rubber compounds.

The majority of chemical products can be handled in the above combination of materials and other alternatives are available if required.

The filter frame is fabricated from structural steel sections which are normally painted with special epoxy paint or, if epoxy paint is not required, in accordance with client requirements.

9. THOROUGH CLEANING OF THE FILTER CLOTH

The cloth on the Delkor belt filter can be efficiently cleaned in several ways. If the cloth is not adequately cleaned by a normal gravity discharge, the cloth can be cleaned by a compressed air blow to remove the cake completely from the cloth.

The cloth is also normally washed continuously on both sides by water sprays. The cloth wash liquor can be used again for the cake wash liquor if disposal of the cloth wash liquor presents effluent problems.

No other filter offers such good washing of all parts in contact with the cake and filtrates on a continuous basis.

If there is any possibility of crystallization of the product, the separation of the cloth from the belt and the easy inspection of the vacuum box for inspection and cleaning are again unique features of the Delkor filter.

10. LOW BUILDING COSTS

The cost of a building for an Delkor belt filter is lower than for a rotary or tilting pan filter of the same capacity. The building requirements for Delkor belt filters are simple and do not require complicated concrete work or high buildings designed for heavy point loads.

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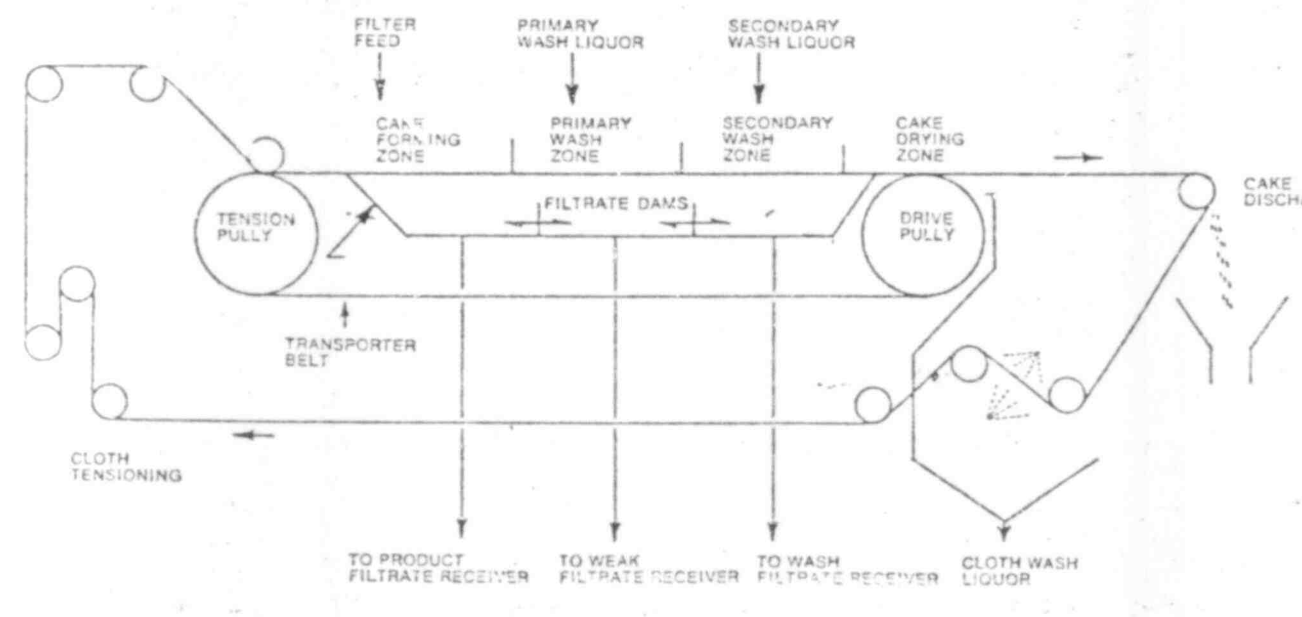
INTRODUCTION

The Delkor Horizontal Belt Vacuum Filter combines the advantages of traditional horizontal belt filters with modern materials and design concepts to give an efficient and reliable filtration system. Washing operations and product filtrate recovery are optimized by the high degree of flexibility embodied in the Delkor filter concept. Simplicity of design and high efficiency result in low first cost, while unique features minimizing friction and wear reduce operating and maintenance costs.

The design of the filter incorporates features that take advantage of modern materials and techniques and eliminate problems associated with other vacuum filters. The Delkor Horizontal Belt Vacuum Filter can be supplied in ... s unmatched by other filters utilizing the horizontal belt principle. Filters are available in sizes from 5.4 to 2150 ft² of effective filtration area in materials of construction compatible with virtually any chemical product.



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OPERATION

The simplified flowsheet shows a filter with two wash zones, producing three filtrate streams. Numerous wash configurations are possible, depending upon process needs.

The feed slurry is distributed onto the moving filter cloth by a fishtail distributor which spreads the slurry evenly across the width of the belt. The cake forming zone is limited by the fixed feed dam roller and the adjustable dam for the primary wash stage. The filtrate from the slurry feed is collected in the first section of the vacuum box, thence to the product filtrate receiver.

The cake moves with the belt under the wash dam to the primary wash zone. Wash liquor is distributed evenly over the cake by means of special wash troughs. Washing approaching theoretical displacement of the mother liquor results. The filtrate from the primary wash section is collected in the second section of the vacuum box and flows to the weak filtrate receiver. In like manner, the cake moves to the secondary wash zone, the filtrate being collected in the final section of the vacuum box and flowing to the wash filtrate receiver.

The final zone of the filter is used for drying the cake. As the belt passes over the vacuum box and the drive pulley, the cake is separated from the belt and is carried forward on the filter cloth to the cake cracking roller where it is discharged from the cloth. The cloth then passes on to the cloth wash trough where it is sprayed on both sides to provide a completely clean cloth before returning to the slurry feed point.

The flow arrangement shown could be utilized for counter current washing. Clean wash liquor is applied as the secondary wash liquor, the wash filtrate obtained in the final section of the vacuum box being returned as primary wash liquor. High purity filter cake can be thus obtained with a minimum of make-up and effluent liquor. Other recycle flow schemes can be implemented depending on the requirements of the individual process.

APPLICATIONS

Filters of this design have found many uses for filtration, drying and washing applications in plants for the chemical, food, specialty chemical and metallurgical industries.

Some of the applications are listed below:

- Gold Slurry
- Uranium Ore Leach Liquor
- Ultra Pure Silica
- Manganese Carbonate
- Sodium Uranate
- Phosphate Rock Drying
- Cordite
- Alumina Gels
- Silica Gels
- Phosphoric Acid
- Boric Acid
- Cellulose Acetate
- Nitrocellulose
- Calcium Saccharate
- Pigments
- Dithane
- Aluminum Sulphate
- E.D.T.A.
- Pharmaceuticals
- Calcium Carbonate
- Citric Acid
- Fluosilicic Acid
- Fluosilicates
- Fungicides
- Gallic Acid
- Nitrogenated Glycols
- Sugar Filtration
- Uranium Fluoride
- Nickel Ore:
  - Hydrochloric Acid
  - Attack Liquor
- Acetic Acid
- Tartaric Acid
- Lactic Acid
- Rare Earth Carbonates
- Titanium Dioxide
- Pentaerythritol

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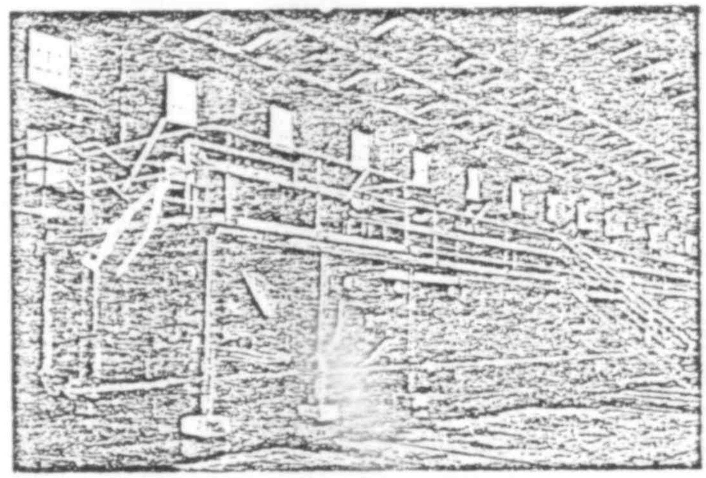
EQUIPMENT SELECTION



ENVIRO-CLEAR DELKOR TEST UNITS

Laboratory and pilot scale testing are employed to determine the technical and economical feasibility of the Enviro-Clear Delkor Horizontal Belt Vacuum Filter operation. "Buchner funnel" filtration tests are performed both at the Enviro-Clear Laboratory and in the field to determine what filtration rates, cake solids and filtrate quality are possible. The filter cloth material and the type of washing and chemical pre-treatment required are also determined.

Larger scale testing is available with a 20 $ft.^2$ fully equipped pilot plant filter. This unit is available for rental and provides a dynamic testing program from which an extremely accurate scale-up to a full-scale filter can be made.

The filtration rate of a particular slurry is the key to sizing the Enviro-Clear Delkor Horizontal Belt Vacuum Filter. The filtration rate is defined as the weight of dry solids, in pounds, processed using one square foot of filter area. This rate is dependent on a number of factors including the characteristics of the slurry, the filter cloth fabric and the amount of washing required. The upper table on Page 9 lists some of the filtration rates obtainable with Enviro-Clear systems. The table also lists the typical feed solids concentrations, cake moisture content, and the amount of washwater used relative to the weight of solids processed. Of course, many other filtering operations may be performed. The lower table lists the capacities, in tons of solids per day, of the various standard size Enviro-Clear Delkor Belt Vacuum Filters. Intermediate size filters are available when required.

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2000 tpd mill
166000 lbs/hr = 270 sq ft

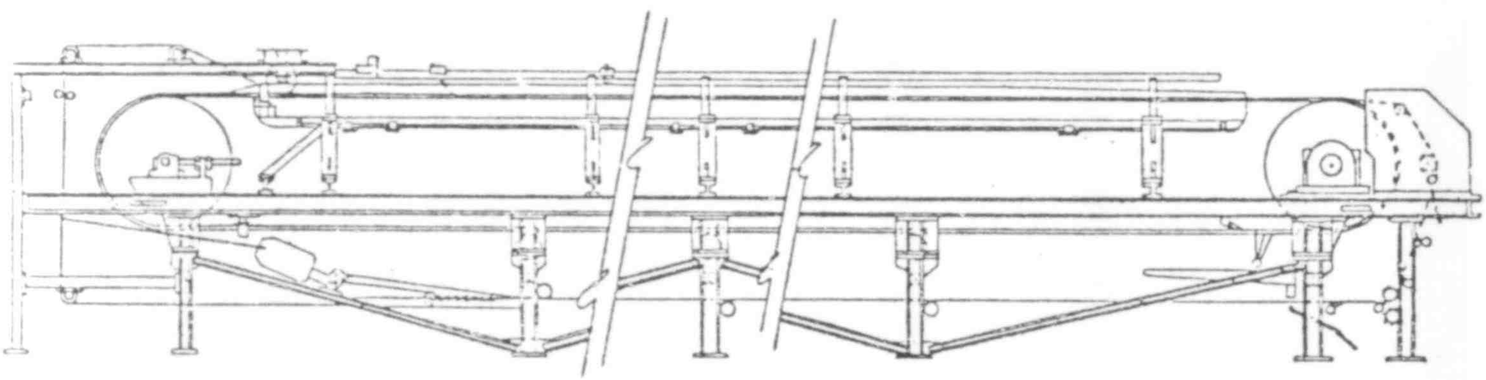
PERFORMANCE OF TYPICAL ENVIRO-CLEAR DELKOR BELT VACUUM FILTERS

APPLICATION	FEED SOLIDS (%)	FILTRATION RATE (LB/HR/FT²)	CAKE MOISTURE (%)	WASH (% DRY SOLIDS)
Chloride Sludge	2	3-18	50	150
Coal Tailings	40	180-900	10-12	0
Copper-Nickel Concentrate (70%)	45	180-300	8	0
Gold Cyanide Leach (70%)	50	90-200	25	100
Gypsum Dewatering Wash	30	120-360	18	150
Phosphoric Acid Reaction Slurry (Gypsum)		18-125		
Pyrite (75%)	48	240-720	18	0
Sodium Fluosilicate	36	40-60	3	0
Uranium Acid Leach (70%)	53 53	120-300 400-600	25 25	60 0
Uranium Sands Wash	50	1800-3600	20	100

CAPACITIES OF ENVIRO-CLEAR DELKOR BELT VACUUM FILTERS

UNIT SIZE (FT² FILTRATION AREA)	FILTRATION RATE IN LB./HR./FT²							
	6	30	60	180	300	600	1500	3000
	CAPACITY IN TONS OF SOLIDS PER DAY							
20	1.4	7	14	43	72	144	360	720
50	3.6	18	36	108	180	360	900	1800
80	5.8	29	58	173	288	576	1440	2880
110	8	40	79	238	396	790	1980	3960
160	11	58	115	346	576	1150	2880	5760
270	19	97	194	583	972	1940	4860	9720
375	27	135	270	810	1350	2700	6750	13500
640	46	230	461	1382	2304	4610	11520	23040
1280	92	460	922	2764	4608	9220	23040	46080

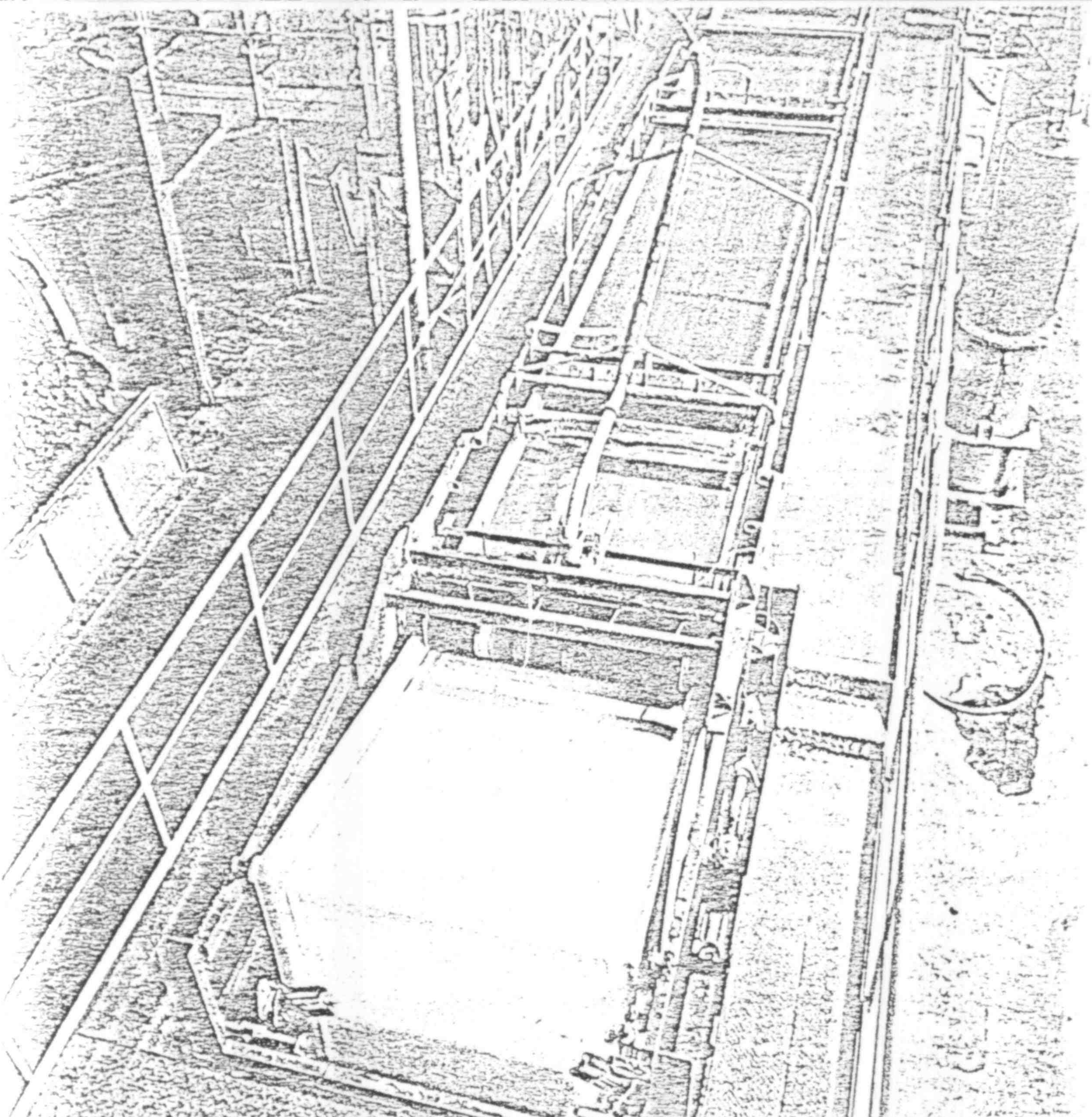
FILTER DIMENSIONS



BELT WIDTH (Feet)	EFFECTIVE FILTRATION AREA (Square feet)	OVERALL FILTER WIDTH (Feet)	OVERALL FILTER LENGTH (Feet)	SHIPPING WEIGHT (Tons)
0.8	5.4	3.9	14.8	1.5
2.0	10.8, 16.1, 21.5, 32.3	5.1	18.0, 21.3, 24.6, 27.9	2.0, 2.3, 2.6, 2.9
3.6	43.0, 53.8, 80.7, 107.6	7.5	32.8, 41.0, 49.2, 57.4	3.5, 3.9, 4.5, 6.5
5.2	81, 108, 135, 162, 215, 269	9.2	33, 39, 46, 51, 62, 72	6.5, 7.5, 8.5, 9.5, 10.5, 11.5
10.5 (2 belts)	325, 430, 540, 645, 755	18.0	51, 62, 72, 84, 95	20, 23, 26, 29, 32
15.7 (3 belts)	860, 970, 1075, 1185, 1290	24.3	77, 84, 92, 98, 105	38, 40, 42, 44, 46
21.0 (4 belts)	1615, 1885, 2150	30.2	102, 115, 128	60, 70, 80

…termediate sizes can be supplied if required

Enviro-Clear
A DIVISION OF Amstar CORPORATION



FOR FURTHER INFORMATION, CONTACT: Enviro-Clear A DIVISION OF Amstar CORPORATION

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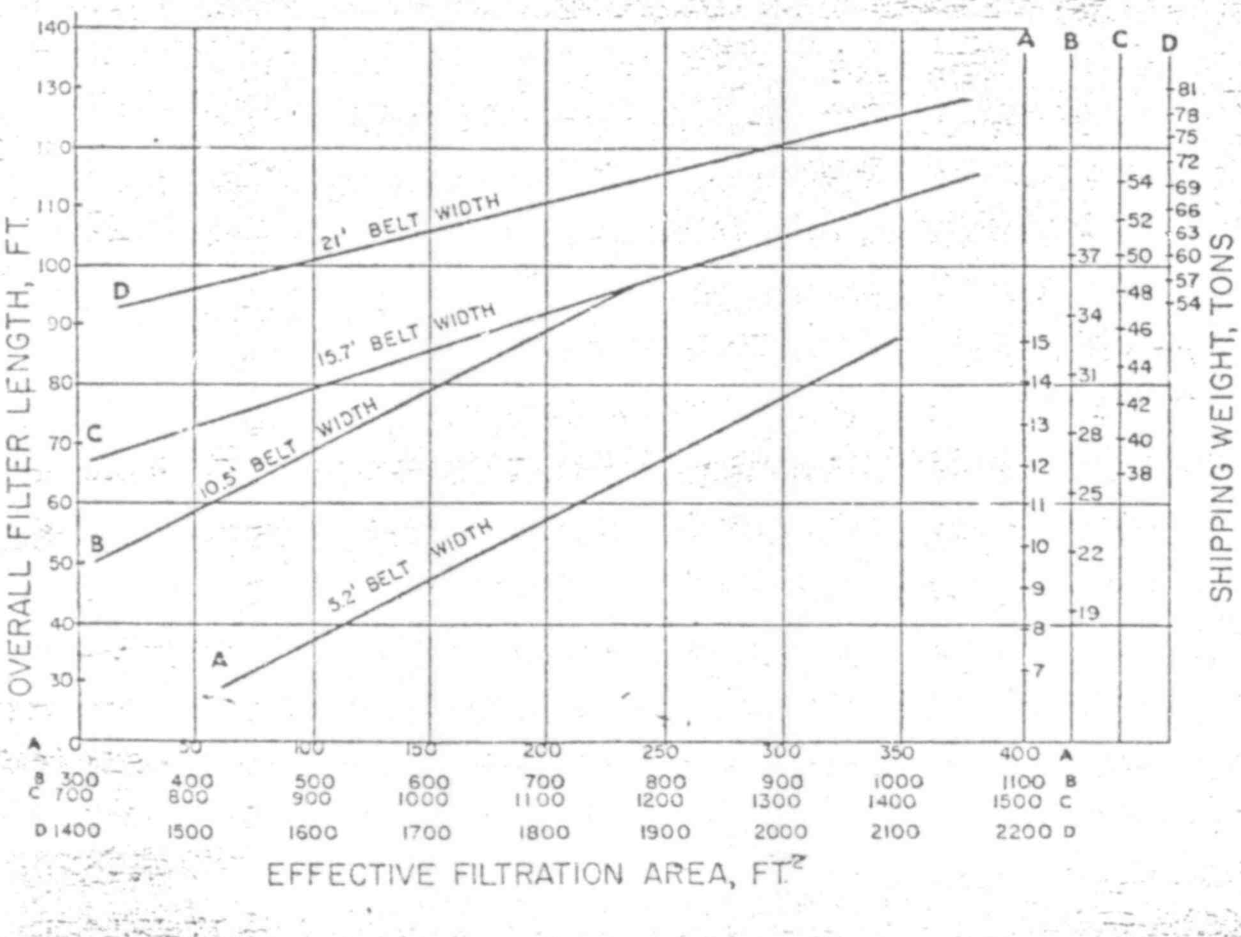
201 526-5454 TWX710-480-9233



POOR ORIGINAL

UNION CARBIDE CORPORATION
METALS DIVISION
P. O. BOX 1029, GRAND JUNCTION, COLORADO 81501
Telephone (303) 245-3700

Vorlon
M-25
ref K-8 #8
K-24 #15

February 1, 1978

Mr. R. A. Scarano
Fuel Processing and Fabrication Branch
Division of Fuel Cycle and Material Safety
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Docket: 40:299
Source Material License: SUA-648

Gentlemen:

Attached is the response to your questions on disposal of tailings below grade as requested in your letter dated January 5, 1978.

Sincerely yours,

P. C. Rekemeyer
Environmental Coordinator

PCR:bnw

Attachment

7908010161

505 212

MEMORANDUM

Review of the Alternatives for Disposal of Mill Tailings Below Grade at the Gas Hills Facility

Union Carbide Metals Division

January 31, 1978

505 213

1.0 Scope

The NRC formally requested on January 5, 1978 that the Company provide information on alternatives for disposal of tailings in a pit near the mill area. The information requested relates to the capacity of usable pits in the vicinity of the mill, options for operating the pit to minimize subsurface contamination and data on the geohydrology of the area.

This memorandum provides the information requested by the NRC. In reviewing this document the following factors must be considered by NRC personnel:

1.1 The submission of this document is in response to the NRC request for information and does not commit the Company to pit disposal of tailings.

1.2 The design on the pit disposal system and the associated costs for each option are based on engineering estimates.

1.3 If a consultant's evaluation and report of the hydrology and geology of the pit areas is required in support of this memorandum it will require 2-4 months and cost approximately $35,000.

2.0 Summary

There are two adjacent pits approximately 4500 feet from the Gas Hills mill which could be utilized to dispose of 3.2 MM tons of mill tailings generated during the projected life of the plant.

The feasibility and estimated capital costs associated with the use of these pits both unlined and with a 45 mil supported hypolan lining were evaluated. The use of clay as a lining material was not considered as less than 20% of the required amount will be generated during the remainder of the mining program.

The preparation of the pit for lining can be done by building a ramp at a maximum slope of 2/1 against the existing pit wall or by cutting and filling from the perimeter to produce a 3/1 slope. Although either procedure can be used the viable technique at Gas Hills is to cut and fill to a 3/1 slope. As construction of an internal ramp reduces the pit volume by greater than 40%; thus not permitting its use to contain the tailings for the project mill life.

A comparison of costs for each case reviewed is summarized below:

Case	Description	Percent of Future Tailings Retained	Estimated Capital Cost ($)
I	Unlined Pit	100	450,000
II	Internal ramp built at a 2/1 slope. 45 mil supported hypolan liner	60	1,700,000
III	Cut and fill from the perimeter @ a 3/1 slope. 45 mil supported hypolan liner	100	2,400,000

These costs estimates in conjunction with an analysis of the geohydrology of the proposed disposal site indicate that of the 3, Case I represents the best choice and should receive further consideration.

3.0 Estimated Volume of Tailings to be Disposed of Over the Mill Life

The Gas hills facility has a projected life of 8 years. At the annual budgeted rate of 500,000 dry tons per year the plant will generate an estimated 410,000 cubic yards of tailings per year, or an accumulated volume over 8 years of 3,280,000 yd^3.

4.0 Potential Disposal Sites

There are two pits, A-9 and C-12, with a common boundary that can be used for below grade disposal of tailings during the projected life of the mill. Their combined volume is estimated at 3,300,000 cubic yards. This and other information is presented below:

Pit	Pit Volume (yd^3)	Area - Acres Top	Area - Acres Bottom	Average Height (ft)
A-9	2,100,000	28	12	100
C-12	1,200,000	17	11.5	100

These pits are shown on the topographical map number 127-77-1, Revision 1, attached. This disposal area ranges between 4000'-4500' in a south easterly direction from the mill.

In the proposed operating sequence Pit A-9 would be filled first; and then it would overflow the dividing berm and raise the level in C-12.

When the level in C-12 reaches the top of the berm the common level will rise to the cut-off elevation of 6940 feet. At this elevation the level in the disposal area will be a minimum of 9 feet below grade.

5.0 Feasibility and Estimated Costs of Using Pits A-9 and C-12 Unlined, Clay Lined, or with a Synthetic Liner

5.1 Unlined Pit

The use of the pit in its natural state presents the least cost alternative for retaining the tailings during the projected mill life. The use of the pit will require the installation of a floating decant system at an estimated cost of $450,000 to maintain the liquid pool over the tailings at a minimum dpeth. The elements of the floating decant system are discussed in section 6.0.

The geohydrology of the pit area and the effect of seepage rates on the area are presented in Section 7.0.

5.2 Clay Lining of Pits A-9 and C-12

An estimate of lining the pit walls with caly at a minimum slope of 1½/1 shows that it will require approximately 1,350,000 yds^3 of clay. Since less than 20% of this quantity is available from the mining program this option was not considered.

5.3 Synthetic Liner for Pits A-9 and C-12

5.3.1 Site Preparation

In order to provide a surface on which a synthetic liner such as PVC, or hypolan can be laid the pit highwalls will have to be reduced from a nominal 1½/1 to 2/1 or 3/1. In addition a smooth surface will have to be prepared so that the liner will not rupture when compressed against a discontinuity.

The alternate sideslope specifications are dictated by the following criteria:

5.3.1.1 The liner manufacturer recommends no greater than a 2/1 sideslope. The method of construction dictates whether the slope will be 2/1 or 3/1.

5.3.1.2 If the existing sidewall of the pit is not disturbed and a ramp is built using overburden from the high wall towards the center of the pit a 2/1 slope can be attained. However, this results in a loss of volume in the pit.

5.3.1.3 If the pit wall is reduced from the perimeter by cutting and filling the maximum slope that heavy equipment can work on safely is 3/1. This operation does not change the volume of the pit, but it increases the area to be covered.

5.4 Evaluation of Building a Ramp in an Existing Pit Per 5.3.1.2

The effect of following the method described in 5.3.1.2 has been estimated for Pit A-9 at a slope of only 1½/1. The calculations show that the pit volume will be reduced by 850,000 yd^3 or 42.5%. Extrapolation of this data for pits A-9 and C-12 reduces the life from approximately 8 years to 3.5 years. In addition the following cost summary applies if a synthetic liner is to be installed.

Item	Estimated Cost ($)
Floating Decant System	450,000
Earthmoving - 850,000 yd^3 @ 1.00/yd^3	850,000
Liner Cost - 45 mil Supported Hypolan 587,000 ft^2 x \$0.75/ft^2	440,000
Total Cost	1,740,000

5.5 Evaluation of Reducing the Sidewall Per 5.3.1.3

The reduction of the sidewall by cutting from the perimeter and filling at the bottom of the pit has the advantage that the storage volume remains constant. However, the surface area that must be covered with a membrane increased from the 586,000 ft^2 to approximately 1,8000,000 ft^2 or by a factor of 3 at the 3/1 side slope. A cost summary is presented below:

Item	Estimated Cost $
Floating Decant System	450,000
Earthwork - 545,000 yd^3 @ \$1.00/yd^3	545,000
Liner - 45 mil Hypolan - supported 1,800,000 ft^2 x \$0.75/ft^2	1,351,000
Total Cost	2,346,000

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Although the cost for this option is approximately $600,000 higher than that in section 5.4 the life of the pit is approximately doubled.

6.0 Preliminary Design and Capital Investment for a Floating Decant System

6.1 Description of the Tailings Disposal System

The use of a pit for disposal of tailings approximately 4500 feet from the mill area will require the following equipment:

6.1.1 A flanged steel pipeline to carry the slurry from the mill area to the pit. The line will have to be supported along the length; and laid along the pit access road.

6.1.2 The liquor that separates from the tailings will form a pool at the low point. In order to recover this liquor for recycle to the plant a second pipelone will be laid beside the slurry line. However, the liquor pickup will be made using a decant pump supported on a floating platform. The connection between the decant liquor return line and the pump on the float will be made using a rubber pipeline.

The power supply for the pump will be supplied by the installation of a diesel generator, including oil storage facilities, along the rim of the pit. The decant pump will be wired to the generator.

6.2 Estimated Capital Investment for the Floating Decant System

The estimated capital costs for the facility are summarized below:

Item	Estimated Cost ($000's)
Pipe trestle at the plant	50
Decant pump and float	45
Pipe 5000 ft 6" steel, rubber lined including support system	100
Pipe 5000 ft 6" PVC including support system	85
Diesel generator and oil storage	40
Total Direct Cost	320
Engineering	65
Contingency @ 20%	65
Total	450

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8.0 Environmental Considerations

Some of the environmental considerations that relate to the disposal of uranium mill tailings below grade are reviewed below.

8.1 Tailings Spills Due to Pipeline Failure

The route that the pipeline takes can be graded or ditched so that any spills will drain to the pit.

8.2 Contamination of Groundwater

The impact of seepage on groundwater or the subsurface environment has to be evaluated on a site specific basis.

If the pit is located in an impacted area with a favorable geohydrology, such as is the case at Gas Hills an unlined pit can be used.

In addition monitor wells can be installed to insure that the seepage does not exceed acceptable values. This monitoring system would also be required for a lined pit to check against membrane failure.

8.3 Reclamation on Mill Decomissioning

The disposal of tailings below grade simplifies the tailings reclamation program. There would be no need to stabilize the sides against wind and water erosion as with a conventional tailings pond.

After the tailings has dried out a clay cap could be used to reduce radon emanation. This could be covered with overburden, topsoil and revegetated.

The total cost of stabilization and maintenance would be reduced. However, no estimate had been prepared for this case.