RESIDUALS DEWATERING AND PROCESSING STUDY

ERIE COUNTY WATER AUTHORITY

VAN DE WATER TREATMENT PLANT

NOVEMBER 2018

wendel

The Erie County Water Authority (ECWA) is an independent public benefit corporation that was created in 1949 and has been in operation since 1953. The ECWA serves more than 540,000 people, 24-hours a day, 365-days a year. To better meet the needs of the ECWA's customers and to better manage available resources, the ECWA is interested in improving operations and energy efficiency within their facilities. Wendel was retained by the ECWA to conduct a study with a primary focus on the Sludge Treatment Facilities at the Van De Water Treatment Plant (VDWTP).

The following analysis outlines the preliminary study and associated costs required for the upgrades for the VDWTP Sludge Treatment Facilities, including sludge thickening, dewatering, pumping systems, and disposal alternatives.

The following sludge thickening alternatives were evaluated for the VDWTP Residuals Study:

Parameter	Alternative #1: Thickener/Clarifier Rehabilitation	Alternative #2: Gravity Belt Thickener	Alternative #3: Rotary Drum Thickener
Effluent Solid Content	2 to 3%	6%	5%
Nameplate Power	12 HP	56 HP	66 HP
Capital Cost	$165,000	$846,000	$813,000
O&M Cost	$1,000	$2,500	$2,500
Chemical Cost	$6,500	$50,000	$99,000
Energy Cost	$1,000	$3,000	$3,500

Our analysis shows that the replacement of the existing Clarifier/Thickener No. 2 with a new gravity thickener or a rotary drum thickener will increase the energy and O&M costs at the VDWTP. Further, the capital cost for the installation of the new gravity thickener or rotary drum thickener is significantly greater than the rehabilitation of the existing system. As such, it is recommended that the WTP rehabilitate and continue to utilize the current gravity sludge thickening system.

The following sludge dewatering alternatives were evaluated for the VDWTP Residuals Study:

Parameter	Alternative #1: Plate and Frame Press	Alternative #2: Centrifuge	Alternative #3: Belt Filter Press
Effluent Solid Content	30 to 33%	20 to 24%	24 to 31.5%
Nameplate Power	213 HP	101 HP	36 HP
Capital Cost	$1,613,000	$1,366,000	$1,225,000
O&M Cost	$36,000	$5,000	$4,000
Chemical Cost	$10,000	$27,000	$13,500
Energy Cost	$12,500	$7,500	$2,500
Landfill Hauling and Disposal Cost	$56,500	$78,000	$59,500

Of the alternatives proposed above, the most feasible is the belt filter press upgrade. This alternative will significantly reduce the operating/chemical costs and improve the electrical savings while offsetting the increased costs associated with additional polymer usage and sludge disposal (landfilling and hauling). Based on our analysis, the belt filter press option resulted in a favorable payback of 14.6 years for the ECWA. The centrifuge option is not recommended due to the longer payback period, additional energy, and increased operations and maintenance (O&M) costs.

Several dewatered sludge disposal options were evaluated including landfill with an increased dumpster capacity, landfill with a sludge dryer, and landfill with an additional dumpster. At this time, changes to the landfill disposal method are not recommended due to the elevated capital costs of the proposed alternatives and significant structural modifications to the existing building with minimal savings. Future considerations should include a more in-depth evaluation of landfilling with an additional dumpster. Adding a second dumpster will allow more flexibility in the Sludge Plant's operation and mitigate delays caused by storage availability and hauling schedule.

It is recommended that the Coagulation/Sedimentation basin blowdown pumps be replaced with new and more efficient pumps. Ultimately, the replacement of the failing pumps will allow the VDWTP to renew critical assets with reduced down time.

Below is the total projected cost for each recommended alternative. Note that the total projected costs include 10% contingency and 25% for Engineering, Legal and Administrative services. Costs for anticipated improvements for the VDWTP Sludge Treatment Facilities given below are ballpark figures subject to change during detailed design. Note that the costs associated with existing and/or abandoned equipment demolition at the VDWTP Sludge Treatment Facilities are not included in the total projected cost.

- Thickener/Clarifier Rehabilitation, total projected cost is $165,000
- Belt Filter Press Upgrades, total projected cost is $1,225,000
- Coagulation/Sedimentation Basin Blowdown Pumps Replacement, total projected cost is $73,000.

Introduction and Purpose

The Erie County Water Authority (ECWA) is an independent public benefit corporation created by a special act of the New York State Legislature known as Title III Article V of the Public Authorities Law to ensure a safe and plentiful water supply for the people and industry of Erie County. In operation since 1953, ECWA is not an agency of New York State nor Erie County government. ECWA currently employs approximately 250 full-time employees.

ECWA owns and operates the Van De Water Treatment Plant (VDWTP), a 49.5 MGD conventional water treatment plant that supplies drinking water to the surrounding community. The treatment plant is located at 3750 River Road, Tonawanda, New York and covers approximately 25 acres. The VDWTP utilizes the Upper Niagara River as its source water and supplies drinking water to the surrounding community. The WTP was placed on-line in 1980 and residuals processing facilities were added in the mid-1980s. Modifications have been made to the residuals processing facilities, including the installation of a new lime feed system, but the overall process has remained the same and most of the process components are original.

The existing VDWTP Sludge Treatment Facilities consist of:

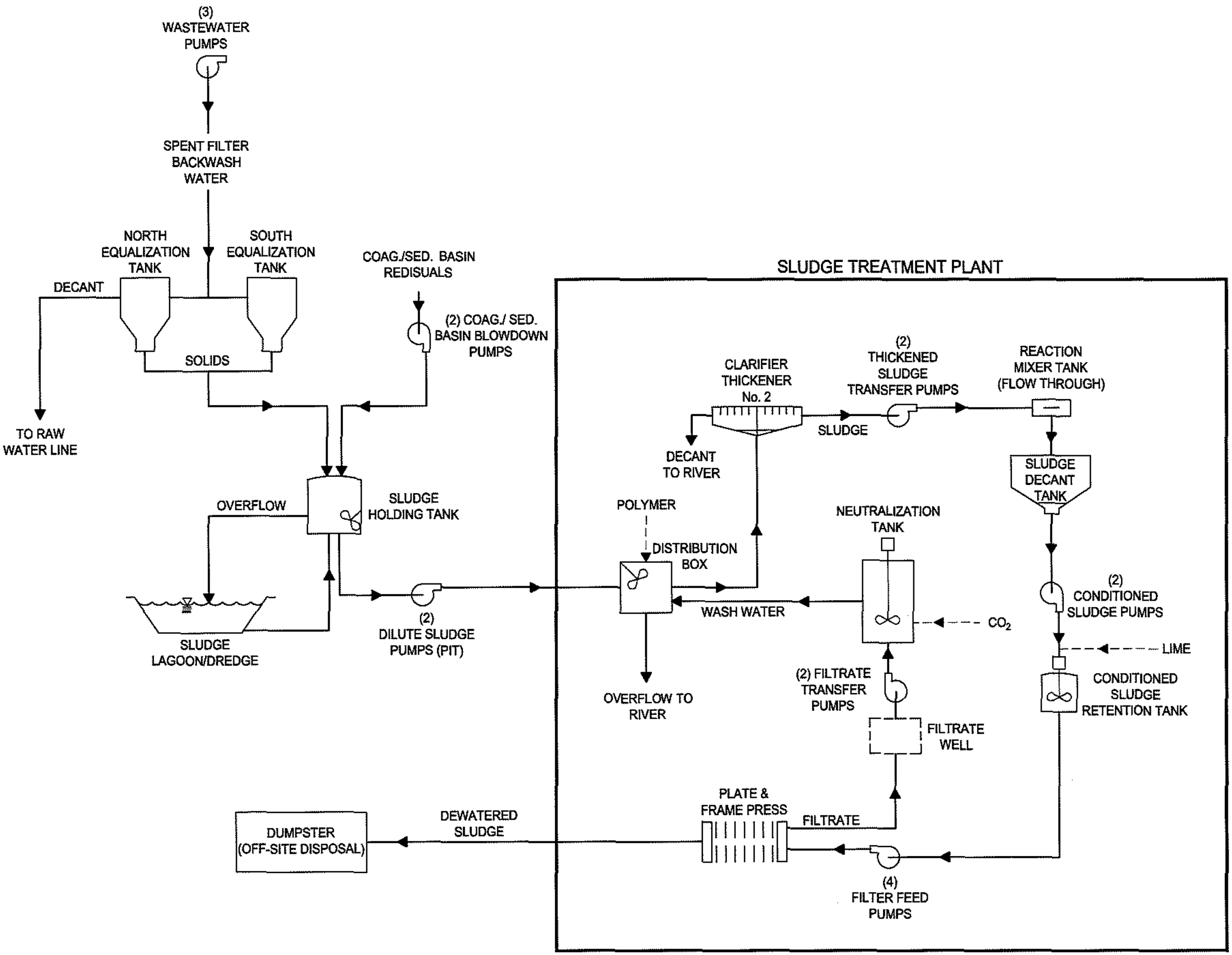
- Sludge pumping equipment:
    - (3) Wastewater Pumps
    - (2) Coagulation/Sedimentation Basin Blowdown Pumps

- Sludge thickening equipment
    - One (1) Distribution box
    - One (1) Clarifier/Thickener
    - One (1) Polypak polymer feed system

- Sludge dewatering equipment
    - Two (2) Thickened sludge transfer pumps
    - One (1) Reaction mixer tank
    - One (1) Sludge decant tank
    - Two (2) Conditioned sludge pumps
    - One (1) Liquid lime feed system
    - One (1) Conditioned sludge retention tank
    - Four (4) Filter feed pumps
    - One (1) Plate and Frame press
    - Two (2) Filtrate pumps
    - One (1) Carbon Dioxide (CO_2) tank
    - One (1) Neutralization tank
    - Two (2) Air compressors

- Sludge disposal equipment
    - One (1) Belt conveyor
    - One (1) 20-cubic yard (CY) dumpster

Refer to Figure 1 for a schematic of the existing Sludge Treatment Facilities at the VDWTP.


(3) WASTEWATER PUMPS
SPENT FILTER BACKWASH WATER
NORTH EQUALIZATION TANK
SOUTH EQUALIZATION TANK
DECANT
SOLIDS
TO RAW WATER LINE
COAG./SED. BASIN REDISUALS
(2) COAG./ SED. BASIN BLOWDOWN PUMPS
SLUDGE HOLDING TANK
OVERFLOW
SLUDGE LAGOON/DREDGE
(2) DILUTE SLUDGE PUMPS (PIT)
SLUDGE TREATMENT PLANT
CLARIFIER THICKENER No. 2
DECANT TO RIVER
SLUDGE
(2) THICKENED SLUDGE TRANSFER PUMPS
REACTION MIXER TANK (FLOW THROUGH)
SLUDGE DECANT TANK
POLYMER
DISTRIBUTION BOX
WASH WATER
OVERFLOW TO RIVER
NEUTRALIZATION TANK
CO_2
(2) CONDITIONED SLUDGE PUMPS
LIME
CONDITIONED SLUDGE RETENTION TANK
(2) FILTRATE TRANSFER PUMPS
FILTRATE WELL
PLATE & FRAME PRESS
FILTRATE
(4) FILTER FEED PUMPS
DEWATERED SLUDGE
DUMPSTER (OFF-SITE DISPOSAL)

The current equipment is antiquated and does not provide the operational flexibility that ECWA desires. Therefore, ECWA would like to upgrade the existing sludge treatment equipment with new equipment to provide greater reliability, operational flexibility, and redundancy. Wendel was authorized by ECWA to perform a basis of design and energy study for the upgrade of the Sludge Treatment Plant. The results of the residuals dewatering and processing study will allow ECWA officials to make informed implementation decisions based on the criteria in Table 1.

Table 1. Evaluation Criteria

Criteria	Description
Capital Cost	Construction cost for the proposed alternative, including related site construction, equipment, piping and appurtenances, building construction, etc.
Annual Operation and Maintenance Costs	Costs to operate and maintain the proposed alternative, including chemical costs, energy costs, operations staff, and costs to maintain the equipment
Performance, Reliability, and Maintainability	A relative measurement of the alternative's performance and reliability, the ease of maintenance, maintenance accessibility, and crew requirements needed to perform maintenance
Ease of Operation	A relative measurement of an alternative's operational simplicity and resources required for operation
Constructability	A relative measurement of the alternative's difficulty in being constructed
System Size and Site Impacts	A relative measurement of the alternative's footprint and how that affects available site space

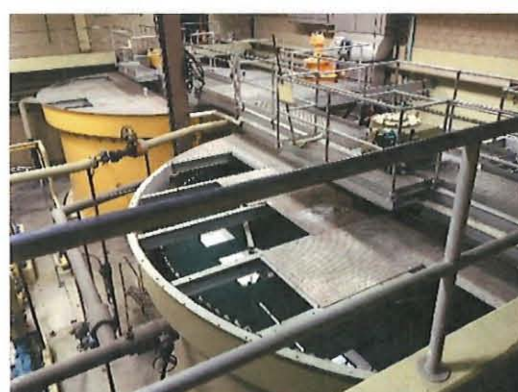
Existing Facilities

Sludge Thickening System

The VDWTP generates residuals from two process streams: coagulation/sedimentation basin residuals and spent filter backwash water. The current residuals treatment process is operated as a batch process.

Sludge from the coagulation basin sludge draw-off pit is pumped by two (2) progressive cavity coagulation/sedimentation (coag./sed.) basin blowdown pumps to a 245,000-gallon steel Sludge Holding Tank. Each pump can deliver 150 GPM at 50 feet of total dynamic head (TDH) with a constant-speed drive and a 30-HP motor. The coag./sed. basin blowdown pumps were installed in 1971. The VDWTP also has the flexibility to pump coagulation basin sludge directly to the on-site lagoon but it is not typically practiced unless the Sludge Holding Tank is being serviced.

Spent filter backwash water flows by gravity to the 70,000-gallon backwash wastewater wet well and is then pumped by three (3) vertical turbine wastewater pumps to one of two (2) 380,000-gallon steel Equalization Tanks. Each wastewater pump has a total capacity of 9,500 GPM at 100 ft of TDH with a 350-HP motor. Two of the three pumps are equipped with VFDs; while one is a constant-speed pump. Under normal operating conditions, only one VFD wastewater pump is operated, the second VFD pump is on standby while the third constant speed pump acts as a redundant backup. The wastewater pumps were originally installed in 1976, but recently rebuilt in 2012.



Settled solids from the spent filter backwash water are discharged by gravity to the 245,000-gallon Sludge Holding Tank (same tank used for holding coagulation/sedimentation basin residuals). The Sludge Holding Tank contains a 50-HP jet mixer (installed in 2017) to homogenize the coagulation and spent filter backwash residuals and keep the solids in suspension. The combined residuals are typically conveyed to a distribution box upstream of a gravity thickener (Clarifier/Thickener No. 2). A dry polymer feed (Polypak) system feeds polymer at the distribution box is used as a sludge thickening aid.

Clarifier/Thickener No. 2 is 24 ft. in diameter and equipped with 200 square feet (SF) of tube settlers to promote gravity settling. Thickened solids scraped from the bottom of the tank are pumped to the Sludge Decant Tank. The solids content of the Clarifier/Thickener effluent ranges from 2% to 3% solids. Decanted supernatant from the thickener flows by gravity to the Niagara River.

The existing sludge thickening system was installed in the 1980s and is beyond its useful life, which has resulted in increased annual energy and operation and maintenance costs. Therefore, several thickening alternatives were evaluated and compared against the existing thickening system.

Sludge Dewatering System

Thickened sludge from the bottom of Clarifier/Thickener No. 2 is pumped by two (2) thickened sludge pumps through the Reaction Mixer Tank to the Sludge Decant Tank, which is currently used as an intermediate holding tank for the Plate and Frame Press. Two (2) conditioned sludge pumps transfer sludge from the Sludge Decant Tank to the Conditioned Sludge Retention Tank. Lime is injected upstream of the Sludge Retention Tank to further condition the sludge. The liquid lime feed system is in operation, to raise the pH of the sludge, whenever there is a press run. From the Conditioned Sludge Tank, piston pumps convey the sludge to the Passavant mechanical plate and frame dewatering press. The operation of the plate and frame press is labor intensive; it takes 4 to 10 hours per run and treats an average sludge inflow of 83 GPM. At the end of each press run an operator must manually scrape the cake on each filter cloth, of the press, into the dewatered sludge hopper located below the press. The piston pumps and the plate and frame press were installed in 1976. Pre-coat chemical can be added before a press run for filter cloth conditioning but is not currently practiced. According to VDWTP personnel, the percent solids of the dewatered sludge is not affected by the pre-coat chemical addition.

The plate and frame press dewaters the lime stabilized sludge to an average of 30 to 33% solids. The performance is greatly dependent on the feed sludge solids concentration, the nature of the solids, and prior sludge conditioning; specifically polymer and lime addition.

Filtrate from the plate and frame press is pumped by two (2) filtrate pumps to a neutralization tank, where carbon dioxide (CO_2) is added to decrease the pH of the filtrate (which is basic due to prior lime addition). The stabilized filtrate flows by gravity to the distribution box, where it is mixed with the coagulation basin and spent filter backwash residuals.

The existing plate and frame press, and belt conveyor have exceeded their useful life and have lost efficiency due to their age and constant wear. The liquid lime feed system was replaced within the last ten years, but it has been a maintenance intensive item for plant operators. It requires significant man-hours and resources to keep the liquid lime feed area clean. In addition, the total power required for the existing sludge dewatering system at the VDWTP is highly energy intensive. Therefore, the potential exists to replace the existing dewatering system with a more efficient system that requires less chemical and energy usage but also provides increased performance.

Sludge Disposal

Dewatered sludge is transported from the dewatered sludge hopper by a belt conveyor to one (1) 20-cubic yard dewatered sludge dumpster and subsequently landfilled. According to Plant personnel, the dumpster can hold sludge cake generated by two plate and frame press runs. Based on 2016 data, it costs $29 per ton of wet sludge cake for disposal and $209 of additional fees per hauling trip. As such, ECWA is paying a total of approximately $56,400 per year for the hauling and disposal of sludge cake. From the preliminary walkthrough at the VDWTP, the disposal room, which houses the conveyor and the sludge dumpster, has limited space available for any additional equipment. ECWA personnel would like to explore different options, other than landfilling, to identify the most feasible disposal method for sludge cake.

Existing Residuals Production

The parameters listed in Table 2 were used for the basis of design of the sludge treatment system at the VDWTP.

Table 2. Existing Parameters Used for Basis of Design of the Sludge Treatment System.

Parameter	Min	Average	Max
Raw Water Flows (MGD)	13.7	20.2	35.5
Dilute Sludge Flow (GPM) at 2 to 3% Solids	33.4	70.4	82.7
Clarifier/Thickener Residuals Decant density (ppm)	0	1,909	4,909
Sludge Decant Tank Residuals Density (ppm)	1,176	4,184	11,447
Filtrate Flow (GPM)	0.4	12.3	23.8
Average Polymer Usage (lbs/yr)		1,980	
Average Lime Usage (lbs/yr)		9,045	
Average % Solids off Existing Plate & Frame Cake		30 to 33%	
Volume of Cake (CY/press)		10	

Evaluation of Process and Equipment Alternatives

Sludge Thickening System

Several options are available for improving the VDWTP's existing sludge thickening system. The options include the rehabilitation of the existing Thickener/Clarifier No. 2 system and the replacement of Thickener/Clarifier No. 2 with a gravity belt thickener or a rotary drum thickener, as described below.

Proposed System – Thickener/Clarifier No. 2 Rehabilitation

The sludge thickening system at the VDWTP includes a distribution box with one (1) 1.0-HP mixer, one (1) 10-HP Polypak feed system, and one (1) clarifier/thickener with 1.0-HP bottom scraper. The sludge thickening system operates once a day, for 2 to 4 hours and generates sludge with a 2 to 3% solids concentration. According to the VDWTP's records and personnel, the existing sludge thickening system requires approximately $6,500 per year for chemical and O&M costs.

Therefore, rehabilitation of the existing sludge thickening system is proposed and includes: replacement of the tube settlers/support structure, baffle wall, bottom scraper and motor, distribution box mixer, and re-coating all tank surfaces. The cost estimate for the Clarifier/Thickener No. 2 rehabilitation is $140,000. The tube settlers are less than 10 years old and may be able to be reused. Further investigation into reusing the tube settlers should be investigated during the detailed design phase.

Based on discussion with ECWA operations staff, the distribution box mixer is at the end of its useful life and should be replaced. As part of the Thickener/Clarifier No. 2 Rehabilitation, the distribution box mixer should also be replaced.

With the implementation of this option, the VDWTP will not realize significant chemical or energy cost savings since the existing system is already energy-efficient and has low maintenance costs. However, the existing system is beyond its useful life, which will result in the potential for increased annual O&M costs and may negatively impact the treatment efficiency. Ultimately, the rehabilitation of the existing sludge thickening system will allow the VDWTP to renew critical assets with reduced down time and maintenance costs in the future.

Proposed System – Gravity Belt Thickener

The existing sludge thickening system is a gravity thickening system that requires longer retention times and area greater footprint when compared to mechanical sludge thickening (gravity belt thickener (GBT) and Rotary drum thickener (RDT)).

A GBT consists of a gravity belt that moves over rollers driven by a variable-speed drive unit. The sludge is conditioned with polymer and fed into a feed/distribution box at one end. The box is used to distribute the sludge evenly across the width of the moving belt as the water drains through and the sludge is carried toward the discharge end of the thickener. The sludge is ridged and furrowed by a series of plow blades placed along the travel of the belt, allowing the water released from the sludge to pass through the belt. After the thickened sludge is removed, the belt travels through a wash cycle.

Field sampling and laboratory testing was performed on the VDWTP sludge by various GBT equipment manufacturers during the week of November 6, 2017. The laboratory results showed that the proposed GBT system is capable of producing a thickened sludge of 6% solids, which is greater than the 2 to 3% solids effluent produced from Clarifier/Thickener No. 2. Since polymer addition is required for the gravity belt thickening process, the total polymer usage of the proposed GBT would be approximately 15,612 lbs. per year, which is approximately eight times greater than the existing polymer usage of 1,980 lbs. per year. There would be no improvement, in terms of labor costs, since the startup procedures for both of the sludge thickening systems are similar. In addition, the proposed GBT system is approximately four times more power-intensive than the existing gravity thickening system. The design parameters of the proposed GBT are as follows:

- Solids Throughput: 1,877 lbs/day
- Expected Polymer Dosage: 8 lbs per dry ton
- Feed Rate: 150 GPM
- Expected Discharge Solids: 6%
- System Components:
    - One (1) 2.0 meter GBT
    - One (1) polymer injection and mixing system
    - One (1) washwater booster pump
    - One (1) sludge feed pump
    - One (1) emulsion polymer make down unit with pump
    - One (1) magnetic flow meter
    - One (1) thickened sludge pump
    - One (1) thickened sludge discharge hopper with pressure sensor

The equipment manufacturer laboratory testing and equipment analysis showed that the replacement of the existing gravity thickening system with a new gravity belt thickener will provide an improvement by 3 to 4% in the solids content of the thickened sludge. However, the GBT system would not provide any energy, chemical or O&M savings to ECWA. As such, the installation of a new GBT system is not recommended.

Proposed System – Rotary Drum Thickener

Similar to the GBT, the rotary drum thickener is also a mechanical sludge thickening system, which was compared against the options of rehabilitating the existing gravity thickening system and the GBT. An RDT system consists of a polymer feed system and rotating cylindrical screens. Polymer is mixed with the sludge in the mixing and conditioning drum. The conditioned sludge is then passed to rotating screen drums, which separate the flocculated solids from the water. Thickened sludge rolls out the end of the drums, while separated water decants through the screens.

Field sampling and laboratory testing for the proposed RDT system was also performed at the same time as the GBT sampling analysis. The laboratory results showed that the proposed RDT system is capable of producing a thickened sludge of 5% solids, which is 2 to 3% greater than the Clarifier/Thickener No. 2 thickened sludge. In addition, the total power required for the proposed RDT system is 56-HP, which is about five times more power-intensive than the existing gravity thickening system. There would be no improvement in terms of labor costs because the startup procedures for both of the sludge thickening systems are similar. Since polymer addition is required for the rotary drum thickening process, the total polymer usage of the proposed RDT would be approximately 31,225 lbs. per year, which is approximately sixteen times greater than the existing polymer usage of 1,980 lbs. per year. The design parameters of the proposed RDT are as follows:

- Solids Throughput: 1,877 lbs/day
- Expected Polymer Dosage: 16 lbs per dry ton
- Feed Rate: 150 GPM
- Expected Discharge Solids: 5%
- System Components:
    - One (1) dual 4x10 RDT
    - One (1) polymer injection and mixing system
    - One (1) washwater booster pump
    - One (1) sludge feed pump
    - One (1) emulsion polymer make down unit with pump
    - One (1) magnetic flow meter
    - One (1) thickened sludge pump
    - One (1) thickened sludge discharge hopper with pressure sensor

The laboratory testing and preliminary calculations show that the replacement of the existing gravity thickening system with a new rotary drum thickener may improve solids content by 2 to 3%. However, the RDT would not provide energy and O&M savings when compared to the existing thickening at the VDWTP. Further, the costs for the capital, energy, and O&M of the new RDT are significant. As such, the installation of a new RDT system not a viable option for the WTP both from an energy savings or an O&M perspective. Table 3 compares the three alternatives for sludge thickening at the VDWTP.

Table 3. Cost Comparison between the Existing Thickener/Clarifier and the Proposed Dewatering Systems

Items	Existing Thickener/ Rehabilitation(1)	GBT	RDT
Percent solids	1 - 3%	6%	5%
Equipment cost	$53,000	$298,500	$282,500
Annual polymer cost	$6,500	$50,000	$99,000
Annual maintenance and replacement parts cost	$1,000	$2,500	$2,500
Annual electrical cost	$1,000	$3,000	$3,500

(1)Existing costs associated with the Thickener/Clarifier were provided by ECWA

Sludge Dewatering System

Several options exist for improving the VDWTP's existing sludge dewatering system. The analyzed options include the replacement of the existing plate and frame press with one new centrifuge or belt filter press, as described below. The proposed systems have been selected to operate at similar frequencies, feed conditions and feed rates as the existing system in order to provide an equal comparison in terms of calculated energy and operational costs.

The option of replacing the existing plate and frame press with a fully automatic plate and frame press was presented to ECWA during the preliminary design stage. As shown in Table 4, there are significant capital, O&M, energy, and chemical costs, for the replacement in-kind option. Due to the costs and intensive O&M requirements, this option was not evaluated further.

According to VDWTP personnel, the liquid lime feed system, which is solely used for conditioning the influent of the existing plate and frame press, has required intensive man-hours and O&M costs to be kept in working condition. ECWA would like to eliminate the use of lime for any system at the plant. Therefore, the addition of lime was not considered in the proposed options. Field sampling and laboratory testing was performed at the VDWTP sludge treatment plant by manufacturers of the proposed sludge dewatering equipment during the week of November 6, 2017.

Proposed System – Centrifuge

Under this option, the use of polymer to condition the combined sludge from the filter backwash water and coagulation/sedimentation blowdown, prior to thickening, would remain unchanged. The centrifugation process is widely used in the water and wastewater treatment industry for sludge thickening and dewatering processes. The proposed centrifugation process analyzed in this study is the solid bowl type. In the solid bowl machine, sludge is fed at a constant flow rate into the rotating bowl, where it separates into dense cake containing the solids and a dilute stream called "centrate". The centrate contains fine, low-density solids and is returned to the head of sludge treatment train. The sludge cake is discharged from the bowl by a screw feeder into a hopper or onto a conveyor belt.

The basis of design for the proposed centrifuge system is as follows:

- Number of units: 1
- Feed Concentration: 2.0% - 3.0% (from existing Clarifier/Thickener)
- Hydraulic feed rate*: 82 GPM @ 3%
- Dewatered Cake Solids: 20% - 24% total solids
- Polymer dosage: 24 - 30 lbs/dry ton
- Bowl diameter: 18 in.
- Maximum bowl speed: 3,500 RPM
- Components:
  - One (1) solid bowl centrifuge
  - One (1) sludge pump
  - One (1) washwater booster pump

- One (1) polymer injection system

*The hydraulic and solids loading rates are based on an 8-hour per day operation.

The proposed energy usage calculations are based on the assumption of operating the centrifuge system approximately eight hours per day five days a week, which is similar to the operation of the existing Plate and Frame press. The manpower will be reduced by one to two hours per sludge dewatering run because the centrifuge does not require manual scraping of sludge from the unit. The operators will be able to spend the extra hours on other O&M activities at the VDWTP. It is important to note that the downside of the elimination of the lime system is that the percent total suspended solids (%TSS) off the centrifuge will be less than what the VDWTP plate and frame press currently achieves; 20 - 24% vs. 30 – 33%. In addition, polymer will be added ahead the centrifuge to promote dewatering in place of lime. This will result in an increase in the polymer dosage and the volume of sludge being hauled offsite, increasing the cost for hauling and disposal by approximately $22,000 per year. The annual energy savings is approximately $5,000 which is not significant enough to offset the increased hauling, O&M, and chemical costs.

Energy savings can be calculated in a variety of ways. In this evaluation, energy savings between the existing and proposed systems is based on 2016 total production and disposal of the WTP's "cake", produced by each system. A significant avoided cost of approximately $36,000 annually will be realized due to the elimination of the plate and frame press, thickened sludge, conditioned sludge, filter feed, and filtrate pumps. The avoided costs are calculated based on the assumed O&M costs of the dewatering system over the next 20 years.

Proposed System – Belt Filter Press

Under this option, the use of polymer to condition the combined sludge from the filter backwash water and coagulation/sedimentation blowdown, prior to thickening, would remain unchanged.

The belt filter press was introduced in the U.S. in the 1970s and has become one of the predominant sludge dewatering systems. The belt filter press system requires polymer addition to condition the influent sludge ahead of the belt press. Conditioned sludge is first introduced on a gravity drainage section where it is allowed to thicken. In this section, a majority of the free water is removed from the sludge by gravity. Following gravity drainage, pressure is applied in a low-pressure section, where sludge is squeezed between opposing porous cloth belts. The final dewatered sludge cake is removed from the belts by scraper blades.

The basis of design for the proposed belt filter press system is as follows:

- Number of units: 1
- Feed Concentration: 2.0% - 3.0% (from the existing Clarifier/Thickener)
- Hydraulic feed rate*: 103 GPM @ 1.5%
- Dewatered Cake Solids: 24% - 31.5% total solids

- Polymer dosage: 12 lbs/dry ton
- Components:
  - one (1) 1.0 meter belt filter press
  - one (1) sludge pump
  - one (1) washwater booster pump
  - one (1) polymer injection system

*The hydraulic and solids loading rates are based on an 8-hour per day operation.

The belt filter press system will be operated for approximately 8 hours per day, 3 days a week instead of 5 days a week when compared to the existing plate and frame press. Moreover, the belt filter press does not require manual scraping of sludge. The operators can spend the extra hours on other O&M activities at the Plant. The downside of eliminating the lime addition is that the %TSS off the 3-belt press will be less than what the WTP currently obtains; 24 - 31.5% vs. 30 - 33%. This will result in an increase in the volume of sludge being hauled offsite, increasing the cost for hauling and disposal by approximately $3,000 per year. However, the combined savings from the annual energy, and O&M of $35,000 is significant enough to offset the increase in hauling and chemical costs.

In this evaluation, energy savings between the existing and proposed systems was based on 2016 total production and disposal of the VDWTP's "cake" produced. The proposed belt filter press system will realize significant annual energy savings of approximately $10,000. The annual operational and maintenance cost savings are approximately $30,000. In addition, a significant avoided cost of approximately $36,000 will be realized annually due to the elimination of the plate and frame press, thickened sludge, conditioned sludge, filter feed, and filtrate pumps. The avoided costs are calculated based on the assumed O&M costs of the dewatering system over the next 20 years. Table 4 compares the three alternatives for sludge dewatering at the VDWTP.

Table 4. Costs Comparison between the Existing Plate and Frame and the Proposed Dewatering System

Items	Existing Plate and Frame(1)	Centrifuge	BFP
Percent solids	30 - 33%	20 - 24%	24 - 31.5%
Equipment cost	$ 630,000	$ 435,000	$ 367,000
Annual chemical cost	$ 10,000	$ 27,000	$ 13,500
Annual maintenance and replacement parts cost	$ 36,000	$ 5,000	$ 4,000
Annual electrical cost	$ 12,500	$ 7,500	$ 2,500
Annual hauling and disposal costs	$ 56,500	$ 78,000	$ 59,500

(1) Existing costs, associated with the plate and frame press, were provided by ECWA.

Proposed System – Conveyor Belt

During a press run, the dewatered cake is dropped from the plate and frame press, which is located on the ground floor, to the press hopper, which is located in the basement directly below the press. The cake is then conveyed from the hopper, up to the ground floor and to the sludge disposal room, which is located adjacent to the plate and frame press room. The existing conveyor belt was installed in 1976 and has caused significant operational issues to the Plant, resulting in delays to the subsequent sludge disposal process. With the installation of a new dewatering system, the configuration of the existing conveyor belt is no longer needed. The dewatered cake from the centrifuge or belt filter press can be discharged onto a conveyor belt that will be located at the output side of the dewatering equipment and onto the sludge disposal room. The proposed conveying process will be housed within the ground floor of the Sludge Treatment Plant.

It is proposed that a new conveyor system be installed with the new dewatering equipment. Detailed layout and configuration of the new conveyor belt should be included in the detailed design phase. The capital cost of a new conveyor belt is estimated at $83,000 and will be added to the cost estimates of the recommended sludge dewatering system.

Sludge Pumping System

As part of this investigation, sludge pumping systems at the VDWTP were evaluated for potential energy efficiency improvements. The pumping systems were investigated to determine the best opportunity for upgrades. Motor horsepower and run hours were evaluated before selection of the equipment for further evaluation. Sludge pumps at the VDWTP are listed in Table 5.

Table 5. Existing Sludge Pumping Systems

Pump Name	Motor HP
Wastewater Pump No. 1	350
Wastewater Pump No. 2	350
Wastewater Pump No. 3	350
Coag./Sed. Basin Blowdown Pump No. 1	30
Coag./Sed. Basin Blowdown Pump No. 2	30
Thickened Sludge Transfer Pump No. 1	5
Thickened Sludge Transfer Pump No. 2	5
Conditioned Sludge Pump No. 1	5
Conditioned Sludge Pump No. 2	5
Pre-Coat Pump No. 1	150
Pre-Coat Pump No. 2	150
Passavant Piston Pump No. 1	2
Passavant Piston Pump No. 2	2
Passavant Piston Pump No. 3	2
Passavant Piston Pump No. 4	2
Filtrate Pump No. 1	5
Filtrate Pump No. 2	5
Total HP	**1,448**

Following the equipment alternatives for the VDWTP's sludge thickening and dewatering facilities, the thickened sludge transfer pumps, conditioned sludge pumps, Passavant piston pumps, pre-coat pumps, and the filtrate pumps will be decommissioned as they are no longer needed for the proposed sludge thickening and dewatering system.

The wastewater and coag./sed. basin blowdown pumps would remain as a crucial part at the VDWTP's sludge plant to transfer blowdown from the coag./sed. basins to the Sludge Holding Tank. Therefore, they were selected to undergo a more in depth review. The wastewater and coag./sed. basin blowdown pumps are operated 90 minutes and 30 minutes per day, respectively. The short run times will limit the energy efficiency improvements, however, due to the significant operation and maintenance issues associated with the coag./sed. basin blowdown pumps identified by VDWTP operations staff, these pumps were evaluated further.

The potential to replace the three (3) 9,500-GPM wastewater pumps with three (3) new variable frequency drive pumps was evaluated from an energy savings perspective. However, the energy and O&M savings are minimal with this in-kind replacement option as the pumps were recently replaced and have minimal O&M issues to date. As such, further wastewater pump upgrades were not considered at this time.

As noted above, the existing progressive cavity coag./sed. basin blowdown pumps are beyond their useful life and have resulted in significantly reduced pumping capacity and increased O&M costs. It is recommended that the VDWTP replace the coag./sed. basin blowdown pumps with two (2) new variable-frequency drive progressive cavity pumps or peristaltic-type hose pumps (manufactured by Watson Marlow/Bredel). Each of the proposed progressive cavity pumps has a capacity of 150-GPM at 50 ft. TDH and 7.5-HP motor, which is significantly less than those of the existing pumps (30 HP). Although the simple payback of the pump replacement is more than 18 years, the reduction in routine O&M costs make them an attractive alternative.

With the implementation of the proposed sludge thickening and dewatering upgrades, the sludge pumping system will have seven (7) pumps, rather than 17 pumps, as shown in Table 6. With fewer pumps in operation at the sludge treatment facilities, the VDWTP will realize significant energy, O&M, and man-hour savings.

Table 6. Proposed Sludge Pumping Systems

Pump Name	Motor HP
Wastewater Pump No. 1	350
Wastewater Pump No. 2	350
Wastewater Pump No. 3	350
Coag./Sed. Basin Blowdown Pump No. 1	7.5
Coag./Sed. Basin Blowdown Pump No. 2	7.5
Washwater Booster Pump No. 1*	15
Sludge Feed Pump No. 1*	15
Total HP	**1,095**

*The washwater booster and sludge pumps are required for both dewatering alternatives

Sludge Disposal System

Currently, it costs ECWA approximately $29 per ton of dewatered sludge and $209 per hauling trip to the landfill to dispose of the VDWTP sludge. There are two options for reducing the hauling and landfill costs:

1. Reduce hauling frequencies
2. Reduce sludge volume by increasing solids content.

In addition to landfill and hauling cost savings, the ECWA is also interested in adding a second dumpster to increase the dewatered sludge storage capacity at the VDWTP.

Option 1 – Landfill with Larger Dumpster

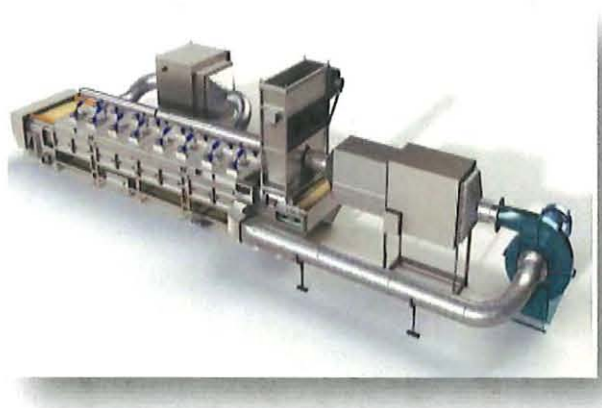
From the proposed upgrades for the sludge dewatering system described previously, the output cake weight from the centrifuge or the belt filter press will be greater as the solids content/water removed is lower. Therefore, reducing the truck hauling trips by increasing the maximum capacity of the sludge dumpster is a potential alternative.

The cost savings attributed to increasing the dumpster size at the VDWTP was investigated. According to plant personnel, the current 20-CY dumpster can hold up to 9 tons of dewatered cake. The hauling contractor offers both 30-CY and 40-CY dumpsters, however, both dumpsters are limited to a capacity of 10 tons of material. From the estimated 120 hauling trips completed each year at a rate of $209 per trip, the current annual cost of the hauling effort is $25,100. If ECWA were to switch to a 30- or 40-CY dumpster, this would reduce the total hauling trips to 108 per year, resulting in an annual cost of $22,600. The hauling cost savings is calculated to be $2,500 and reduces the number of hauling trips by 12 trips per year. This estimate was completed with the assumption that the cost per hauling trip would remain at $209, even with a larger dumpster.

At this time, Wendel does not recommended increasing the dumpster capacity as the cost savings are not significant and may require modifications to the existing building.

Option 2 – Landfill with Sludge Dryer

The VDWTP currently uses polyaluminum (PACl) as their coagulant. The sludge generated from the PACl does not benefit the soil and is typically used as filler material for non-food chain crops, mine reclamation areas, and forests or be buried in a landfill per current practice. Therefore, the installation of a sludge dryer, as an alternate, to reduce the volume of dewatered solids was considered for sludge processing. The current plate and frame press system produces dewatered cake with 30 to 33% solids. If the VDWTP proceeded with a belt filter press for sludge dewatering, the dewatered cake will contain 24% to 31.5% solids. With the addition of a sludge dryer downstream of the dewatering equipment, the plant will be able to further dry the wet cake to achieve 90% solids or higher through the addition of thermal energy.



The advantages and disadvantages of the sludge dryer include:

Advantages:

- Reduce the volume and weight of sludge to reduce transport and disposal costs
- Final product is dried and sanitized with minimal odors.
- Efficient and maintenance-friendly operation

Disadvantages:

- Moderate to high capital costs
- Requires thermal energy input (electrical, natural gas, biogas, waste heat or steam)
- Requires a significant building footprint for all of the sludge dryer components.

Assuming the proposed sludge dryer is installed downstream of the proposed centrifuge or belt filter press, the sludge dryer will have the following operating parameters:

- Number of Dryers: 1
- Pre-drying solids content: 25%
- Post-drying solids content: 92%
- Feed Rate to Dryer: 5 wet tons/day*
- Water Removal: 3.78 tons/day
- Solids Production: 1.41 dry tons/day
- Operating Schedule: 8 hours/day, 4 days/week

*Based on the existing dewatered cake weight of 1,080 wet tons per year at 20 to 30% solids

With the design parameters above, the sludge dryer will be capable of drying 1,080 wet tons of biosolids cake from a 25% solids content to 92% solids content. The annual landfill cost will be reduced to approximately $20,500 compared to the existing landfill cost of $56,400. The potential landfill savings of $36,000 can offset the annual sludge dryer operating costs (including electricity and thermal energy) of $14,000. The equipment and installation costs of a complete sludge dryer system is approximately $1,500,000, which gives a simple payback period of approximately 67 years.

Option 3– Landfill with Additional Dumpster

According to Plant personnel, there have been times that the existing dewatered sludge dumpster is filled but the hauling contractor could not haul the sludge offsite on schedule. A sludge run cannot start when there is no storage capacity for the dewatered sludge, which interrupts the continuous operation of the Sludge Plant. Therefore, adding a second dumpster will add more flexibility to the Sludge Plant's operation and mitigate delays caused by storage availability and hauling schedule. However, the existing sludge disposal room has limited space available for the addition of another 20-CY dumpster. New guide rails and room expansion, including the removal of walls between the sludge storage room and the plate and frame room, will be required. No savings will be recognized with this option, as the disposal and hauling costs will remain the same and there is a significant capital cost associated with structural modifications.

At this time, Wendel does not recommend the addition of a second dumpster since it will require significant structural modifications to the existing building with no associated savings. However, this option can be evaluated in more detail during the design phase.

Opinion of Probable Construction Costs

The following assumption was made for the construction cost estimates:

- The total projected opinion of probable construction costs include 30% for contingency (design and construction) and 25% for engineering legal, project implementation, and administrative (ELA) expenses.

Table 7 summarizes the probable construction cost (equipment capital cost and installation) of each alternative described in Section 3 – Evaluation of Process and Equipment Alternatives. The demolition costs of the decommissioned solids handling equipment, for each of the alternatives listed below, were not included. Refer to Appendix A for detailed cost estimates of the improvements.

Table 7. Opinions of Probable Construction Cost of each Alternative

Upgrade Alternative	Costs
Clarifier/Thickener No. 2 Rehabilitation	$165,000
Rotary Drum Thickener	$813,000
Gravity Belt Thickener	$846,000
Centrifuge	$1,366,000
Belt Filter Press	$1,225,000
Conveyor Belt	$130,000
Coagulation/Sedimentation Basin Blowdown Pump Replacement	$73,000
Sludge Dryer	$1,500,000

Recommendations

Upgrades to the existing VDWTP sludge treatment plant are recommended based on the evaluation criteria described in Table 1. The evaluation criteria are further broken down to a matrix scoring system to give each criteria a score (from 1 to 5: 1 = poor and 5 = good) as shown in Table 8. A weight percentage, which was assigned based on input from ECWA, is also assigned to each evaluation criterion. The weight percentage is multiplied by the score to give a weighted score for each category. The total weighted score of each alternative is the sum of the weighted score assigned to the six criteria.

Table 8. Matrix Scoring System of the Evaluation Criteria

Scale		**Poor**				**Good**
Criteria	Weight	1	2	3	4	5
Capital Cost ($)	25%	Greater than $	$ - $	$ - $	$ - $	Less than $
Annual Operating & Maintenance Cost (Thousands of $)	20%	Greater than $	$ - $	$ - $	$ - $	Less than $
Performance, Reliability and Maintainability	20%	Many mechanical problems during 20-yr period; equipment is very difficult to access and maintenance intensive		⟺	Minimal mechanical problems during 20-yr period; equipment is easily accessible and easy to perform maintenance on	
Ease of Operation	25%	Very high system complexity; many variables for staff to operate		⟺	Low system complexity; few variables for staff to operate	
Constructability	5%	High impact on current operations, complex sequencing, high potential for equipment delays, and higher probability of schedule delays due to construction complexity		⟺	Minimal impact on current operations, readily available equipment, and reasonable schedule with little potential for delays	
System Size and Site Impacts	5%	Many pieces and parts; large footprint; difficulty fitting within existing space		⟺	Few pieces and parts; small footprint; fits within existing space	
TOTAL	100%					

Sludge Thickening System

From the lab analysis and the sludge thickening system evaluation, the replacement of the existing Clarifier/Thickener No. 2 with a new gravity thickener or a rotary drum thickener will significantly increase the energy and O&M costs associated with the VDWTP sludge treatment system. Further, the capital cost for the installation of the new gravity thickener or rotary drum thickener is significantly greater than the rehabilitation of the existing system. Table 9 shows the weighted score of each evaluation criterion for the sludge thickening alternatives.

Table 9. Evaluation Criteria of Sludge Thickening Alternatives

Alternative 1 – Rehabilitation of the existing Clarifier/Thickener No. 2		
Criteria	**Score**	**Weighted Score**
Capital Cost	5	1.25
Annual Operating and Maintenance Cost	5	1.0
Performance, Reliability, and Maintainability	3	0.6
Ease of Operation	5	1.0
Constructability	5	0.25
System Size and Site Impacts	3	0.15
Total	26/30	**4.25/5**
Alternative 2 – Gravity Belt Thickener		
Capital Cost	2	0.5
Annual Operating and Maintenance Cost	3	0.6
Performance, Reliability, and Maintainability	4	0.8
Ease of Operation	4	1.0
Constructability	3	0.15
System Size and Site Impacts	3	0.15
Total	19/30	**3.2/5**
Alternative 3 – Rotary Drum Thickener		
Capital Cost	3	0.75
Annual Operating and Maintenance Cost	2	0.4
Performance, Reliability, and Maintainability	4	0.8
Ease of Operation	4	1.0
Constructability	3	0.15
System Size and Site Impacts	3	0.15
Total	19/30	**3.25/5**

From Table 9, it is recommended that ECWA rehabilitate and continue to utilize the current gravity sludge thickening system and not install a mechanical thickening system.

Sludge Dewatering System

From the lab analysis and the sludge dewatering system evaluation, it is recommended to decommission the current sludge dewatering system, including the thickened sludge transfer pumps, sludge decant tank, conditioned sludge pumps, liquid lime system, conditioned sludge retention tank, filter feed pumps, plate and frame press, CO_2 tank, neutralization tank, and air compressors, in their entirety. Decommissioning the plate and frame press and associated equipment will mitigate further increases in energy, O&M and repair costs associated with the existing dewatering system.

The matrix scoring table (Table 10) was constructed to determine which of the two sludge dewatering alternatives, centrifuge or belt filter press, is more feasible. With a weighted score of 3.7 out of 5, the new belt filter press and conveyor alternative is the recommended option for the VDWTP. This option will significantly reduce the operating/chemical costs and significantly improve the electrical savings while offsetting the increased polymer usage and landfilling/hauling costs. The belt filter press option showed a favorable payback of 14.6 years. The centrifuge option is not recommended due to the longer payback period, higher energy requirements, and increased O&M.

Due to the significant decrease in power, the belt filter press option is eligible for the National Grid Retrofit Program. National Grid offers incentives to help commercial and industrial customers with the replacement of aging an inefficient equipment with more energy efficient technologies. The incentive is a one-time payment that offers approximately $0.12/kWh of electrical savings. The estimated National Grid incentive for the belt filter press option is approximately $17,300 and decreases the payback period to 14.3 years.

Table 10. Evaluation Criteria of Sludge Dewatering Alternatives

Alternative 1 – Centrifuge		
Criteria	**Score**	**Weighted Score**
Capital Cost	3	0.75
Annual Operating and Maintenance Cost	2	0.4
Performance, Reliability, and Maintainability	3	0.6
Ease of Operation	3	0.75
Constructability	4	0.2
System Size and Site Impacts	3	0.15
Total	18/30	**2.85/5**
Alternative 2 – Belt Filter Press		
Capital Cost	3	0.75
Annual Operating and Maintenance Cost	4	0.8
Performance, Reliability, and Maintainability	4	0.8
Ease of Operation	4	1.0
Constructability	4	0.2
System Size and Site Impacts	3	0.15
Total	22/30	**3.7/5**

Sludge Pumping System

The energy analysis shows that the replacement of the wastewater pumps will not provide energy savings. Further, the capital cost for the construction of the new pumps is significant. As such, the wastewater pumps replacement is not a viable option for the VDWTP from an energy and O&M savings perspective.

It is recommended that the coag./sed. basin blowdown pumps be replaced in-kind with new more efficient pumps. Although some energy savings will be realized with the replacement of this pump set, the reduction in routine operation and maintenance costs makes this an attractive option. Ultimately, the replacement of the failing pumps will allow the VDWTP to renew critical assets with reduced down time.

Sludge Disposal Improvement

The sludge disposal improvements were not the priority of this study; hence, ECWA may want to proceed with the recommendations below, in the future, when funding is available.

Even though the sludge dryer is not recommended as a disposal alternative due to project budget constraints, high capital cost, and additional thermal demand; it becomes more feasible when pairing up with the belt filter press installation option. The estimated payback time for the belt filter press and sludge dryer combination is 28.6 years. The combined sludge dewatering and drying system provides a collateral benefit of asset renewal resulting in not only modernized infrastructure, but new equipment to maintain the long-term reliability of the sludge treatment facilities at the VDWTP.

Ancillary System Improvements

In addition to the recommendations discussed previously, there are other items that should be addressed in regards to the VDWTP sludge treatment system. These items should be further detailed during detailed design. These items include:

1. Repair/replacement of the floor drain system within the basement of the sludge building.

2. Replacement of existing pneumatic actuators with electric actuators on the valves within the sludge treatment facility. This may allow for the removal of the air compressors currently installed in the basement of the sludge building.

3. Decommissioning and demolition of ancillary components related to the sludge treatment process that are no longer used and which will not be used with the recommended process upgrades. It may be possible for ECWA to salvage the unused equipment. The salvage value of the equipment may help to offset costs associated with demolition and removal of the unused equipment. In addition, some of the lime feed equipment may be able to be repurposed/reused with the new residuals treatment system.

4. Based on the decreased power requirements for the recommended residuals treatment equipment it is anticipated that the existing electrical is suitable for the new equipment.

5. As part of the detailed design of the new residuals system, the existing building HVAC and lighting should be evaluated. It is anticipated that new HVAC equipment may be required to meet best industry practices. Upgrading the lighting may also provide energy savings and aid in operator O&M of the new residuals system.

Mobilization Plan

As there is no redundancy associated with the existing Clarifier/Thickener No. 2 and the Plate and Frame Press, a mobilization plan and sequence of construction are crucial to the rehabilitation of the existing Clarifier/Thickener No. 2 and the installation of the proposed belt filter press. The following sludge handling and storage alternatives will be examined in more detail during the design phase to maintain continuous residuals treatment at the Sludge Plant:

- Lagooning: maximum capacity of the sludge lagoon at the VDWTP will be evaluated to estimate the available volume and the detention time. This will affect the sequence of construction for installation of new equipment.

- Portable/temporary sludge dewatering equipment: influent sludge flow, sludge throughput, and influent/effluent percent solids will be evaluated to size portable/temporary sludge dewatering equipment (belt filter press) to treat residuals while the plate and frame press is being replaced (plate and frame is decommissioned but the proposed belt filter press is not yet in service).

- By-pass pumping: maximum sludge flow, total dynamic head, and percent solids through the existing Thickener/Clarifier No. 2 and the Plate and Frame Press will be evaluated to size an adequate by-pass pumping and piping system to bypass the sludge flow to a portable/temporary sludge dewatering system.

Conclusions

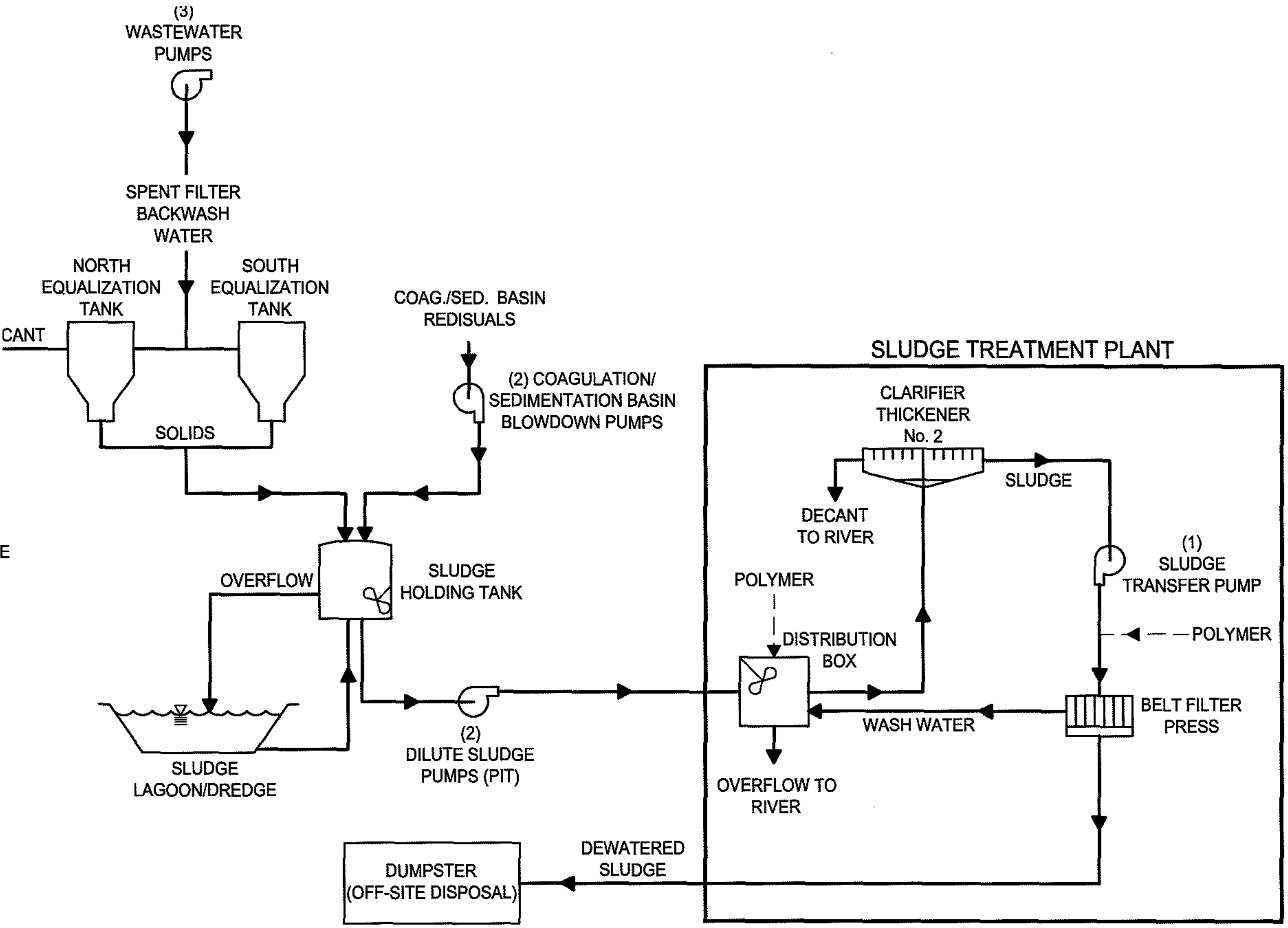
Comprehensive improvements should be implemented at the VDWTP Sludge Treatment Facilities to maintain long-term, reliable, and continuous operation. The most technically feasible and cost effective alternative approach is outlined in Section 5 – Recommendations, and summarized below:

- Rehabilitate Thickener/Clarifier No. 2
- Decommission the existing plate and frame press dewatering and conveyor system and replace with a belt filter press and associated conveyor system.
- Replace the aging coagulation/sedimentation basin blowdown pumps with new more efficient pumps
- Demolish the lime feed system and other ancillary equipment not required for the new sludge processing facilities
- Repair/replace the floor drain system within the basement of the sludge building

The projected cost estimate for the recommended improvements is $1,595,000, excluding floor drain repairs and equipment demolition costs.

The installation of a sludge dryer downstream of the proposed belt filter press, to convert the dewatered sludge to a dryer solids (approximately 90% solid content), may be an option in the future if hauling and disposal costs become more expensive. At this time the inclusion of a sludge dryer brings the opinion of probable costs to $3,095,000, excluding floor drain repairs and equipment demolition costs. When coupled with the belt filter press, the sludge dryer provides a 28.6-year payback as opposed to a 17.2-year payback with the belt filter press alone.

Refer to Proposed Schematic (Fig. 2) for the recommended upgrades to the Sludge Treatment Facilities at the VDWTP.


(3)
WASTEWATER
PUMPS
SPENT FILTER
BACKWASH
WATER
NORTH
EQUALIZATION
TANK
SOUTH
EQUALIZATION
TANK
CANT
SOLIDS
COAG./SED. BASIN
REDISUALS
(2) COAGULATION/
SEDIMENTATION BASIN
BLOWDOWN PUMPS
E
OVERFLOW
SLUDGE
HOLDING TANK
SLUDGE
LAGOON/DREDGE
(2)
DILUTE SLUDGE
PUMPS (PIT)
SLUDGE TREATMENT PLANT
CLARIFIER
THICKENER
No. 2
SLUDGE
DECANT
TO RIVER
(1)
SLUDGE
TRANSFER PUMP
POLYMER
DISTRIBUTION
BOX
POLYMER
BELT FILTER
PRESS
WASH WATER
OVERFLOW TO
RIVER
DUMPSTER
(OFF-SITE DISPOSAL)
DEWATERED
SLUDGE

Appendix A

Opinions of Probable Cost

Description	Qty.	Unit	Material		Labor	
			Unit Price	Total	Unit Price	Total
	1	LS	$2,070	$2,070	$661	$661
ıs (5%)	1	LS	$3,450	$3,450	$1,102	$1,102
ıfit (3%)	1	LS	$2,070	$2,070	$661	$661
Settlers (includes support structure and baffle wall)	1	Ea.	$51,000	$51,000	$10,000	$10,000
Settlers, Support Structure, and Baffle Wall	1	LS			$3,000	$3,000
	1	LS			$2,000	$2,000
	1	LS	$2,000	$2,000	$3,200	$3,200
ɔution Box Mixer	1	LS	$2,000	$2,000	$640	$640
	1	LS	$14,000	$14,000	$3,200	$3,200
		SUBTOTALS:	Materials:	$76,590	Labor:	$24,464

Contingency:	30.0%
TOTAL DIRECT CONSTRUCTION COST:	
Engineering, Legal & Administration	25.0%
	TOTAL:

ndel

Description	Qty.	Unit	Material		Labor	
			Unit Price	Total	Unit Price	Total
	1	LS	$11,424	$11,424	$2,645	$2,64
(5%)	1	LS	$19,040	$19,040	$4,409	$4,40
t (3%)	1	LS	$11,424	$11,424	$2,645	$2,64
ıer (incl. VFD drives, controls, flow meter, sludge pump, mer system)	1	Ea.	$298,500	$298,500	$44,775	$44,77
Demolition	1	LS			$30,000	$30,00
s	1	LS	$40,000	$40,000	$6,400	$6,40
	1	LS	$37,300	$37,300	$2,000	$2,00
;raming	1	LS	$5,000	$5,000	$5,000	$5,00
		SUBTOTALS:	Materials:	$422,688	Labor:	$97,87

ndel

Contingency:	30.C
TOTAL DIRECT CONSTRUCTION COST:	
Engineering, Legal & Administration	25.C
TOTAL	

Description	Qty.	Unit	Material		Labor	
			Unit Price	Total	Unit Price	Total
	1	LS	$10,944	$10,944	$2,573	$2,57
(5%)	1	LS	$18,240	$18,240	$4,289	$4,28
t (3%)	1	LS	$10,944	$10,944	$2,573	$2,57
ɘner (incl. VFD drives, controls, flow meter, sludge pump, mer system)	1	Ea.	$282,500	$282,500	$42,375	$42,37
Demolition	1	LS			$30,000	$30,00
s	1	LS	$40,000	$40,000	$6,400	$6,40
	1	LS	$37,300	$37,300	$2,000	$2,00
;raming	1	LS	$5,000	$5,000	$5,000	$5,00
		SUBTOTALS:	Materials:	$404,928	Labor:	$95,21

Contingency: 30.0

TOTAL DIRECT CONSTRUCTION COST:

ndel

Engineering, Legal & Administration 25.0

TOTAL

: (3%)	1	LS	$18,744	$18,744	$3,971	$3,97
) drives, controls, flow meter, sludge pump, booster em)	1	Ea.	$435,000	$435,000	$65,250	$65,25
ess Demolition	1	LS	$25,000	$25,000	$50,000	$50,0C
;	1	LS	$40,000	$40,000	$6,400	$6,4C
	1	LS	$37,300	$37,300	$1,600	$1,6C
raming	1	LS	$5,000	$5,000	$5,000	$5,0C
lation	1	Ea.	$82,500	$82,500	$4,125	$4,12
	SUBTOTALS:		Materials:	$693,528	Labor:	$146,9

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Contingency: 30.(

TOTAL DIRECT CONSTRUCTION COST:

Engineering, Legal & Administration 25.(

TOTAL

: (3%)	1	LS	$16,707	$16,707	$3,666	$3,66
:l. controls, hydraulic units, booster pump, sludge feed ng unit, startup)	1	Ea.	$367,100	$367,100	$55,065	$55,06
ess Demolition	1	LS	$25,000	$25,000	$50,000	$50,0C
s	1	LS	$40,000	$40,000	$6,400	$6,4C
	1	LS	$37,300	$37,300	$1,600	$1,6C
raming	1	LS	$5,000	$5,000	$5,000	$5,0C
lation	1	Ea.	$82,500	$82,500	$4,125	$4,12
		SUBTOTALS:	Materials:	$618,159	Labor:	$135,63

Contingency:	30.(
TOTAL DIRECT CONSTRUCTION COST:	
Engineering, Legal & Administration	25.(
	TOTAL

t Filter Press and Sludge Dryer
'01/18

Approved by:
File: Cost Estimate

Description	Qty.	Unit	Material		Labor		
			Unit Price	Total	Unit Price	Total	
(3%)	1	LS	$35,937	$35,937	$8,940	$8,940	
litions (5%)	1	LS	$59,895	$59,895	$14,900	$14,900	
d Profit (3%)	1	LS	$35,937	$35,937	$8,940	$8,940	
ess (incl. controls, hydraulic units, booster pump, pump, polymer mixing unit, startup)	1	Ea.	$367,100	$367,100	$55,065	$55,065	
ime Press Demolition	1	LS	$25,000	$25,000	$50,000	$50,000	
cations	1	LS	$40,000	$40,000	$6,400	$6,400	
	1	LS	$37,300	$37,300	$2,000	$2,000	
Reprograming	1	LS	$5,000	$5,000	$5,000	$5,000	
	1	Ea.	$641,000	$641,000	$96,150	$96,150	
on Engineering by Manufacturer	1	LS			$24,000	$24,000	
nd Site Engineering by Manufacturer	1	LS			$55,250	$55,250	
t Installatiom	1	Ea.	$82,500	$82,500	$4,125	$4,125	
		SUBTOTALS:	Materials:	$1,329,669	Labor:	$330,769	

Contingency:	30.0%	
TOTAL DIRECT CONSTRUCTION COST:		
Engineering, Legal & Administration	25.0%	
TOTAL:		

vendel

(3%)	1	LS	$19,380	$19,380	$5,412	$5,41
	1	Ea.	$641,000	$641,000	$96,150	$96,15
ineering by Manufacturer	1	LS			$24,000	$24,0C
Engineering by Manufacturer	1	LS			$55,250	$55,25
raming	1	LS	$5,000	$5,000	$5,000	$5,0C
	SUBTOTALS:		Materials:	$717,060	Labor:	$200,24

ndel

Contingency: 30.(

TOTAL DIRECT CONSTRUCTION COST:

Engineering, Legal & Administration 25.(

TOTAL

	1	LS	$800	$800	$415	$41
(5%)	1	LS	$1,333	$1,333	$692	$69
: (3%)	1	LS	$800	$800	$415	$41
incl. control panel, VFD, shipping)	2	Ea.	$13,331	$26,662	$3,500	$7,0C
	2	Ea.			$2,666	$5,33
raming	1	LS			$1,500	$1,5C
		SUBTOTALS:	Materials:	$29,595	Labor:	$15,35

wendel

Contingency:	30.(
TOTAL DIRECT CONSTRUCTION COST:	
Engineering, Legal & Administration	25.(
	TOTAL

Preliminary Financial Projections

	($)	(kWh)		(kW)	(mmBtu)	(Gallons)	
Clarifier/Thickener No. 2 Rehabilitation	$165,000	268	0.3	3.1	0	0	
Gravity Belt Thickener Upgrades	$846,000	-27,977	-26.9	-322.8	0	0	-$4
Rotary Drum Thickener Upgrades	$813,000	-34,371	-33.0	-396.6	0	0	-$9
Centrifuge Upgrades	$1,366,000	56,799	77.2	926.3	0	0	$2
Belt Filter Press Upgrades	$1,225,000	144,874	114.6	1,375.8	0	0	$6
Belt Filter Press and Sludge Dryer Upgrades	$2,699,000	46,998	55.8	669.9	-1,731	0	$9
agulation/Sedimentation Basin Blowdown Pumps	$73,000	1,516	4.2	49.8	0	0	$1
PROGRAM TOTALS - Recommended Measures	**$1,463,000**	**146,658**	**119**	**1,428.7**	**0**	**0**	**$6**

sts (subcontractor material and labor) and DOES include fees for services described below:
uction documents, Financing assistance services, Subcontractor coordination and administration
Payback is given by the total measure cost divided by total annual savings.

Product Information

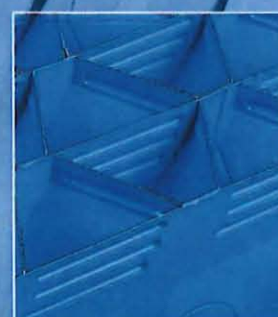
ACCU-PAC® TUBE SETTLERS

City of Myrtle Beach, South Carolina

Sha Tin Water Treatment Works, Hong Kong, China

NSF®

Certified to ANSI/NSF 61



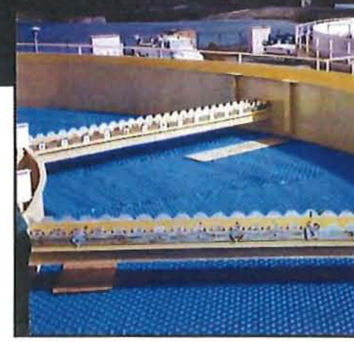
Structural Ribs

AccuPac®

6000-Series Tube Settlers improve plant efficiency and quality for water clarification in potable water and wastewater applications.

BRENTWOOD INDUSTRIES

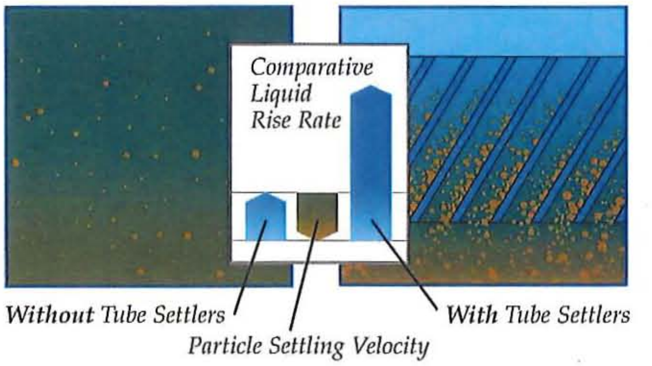
ACCU-PAC® TUBE SETTLERS



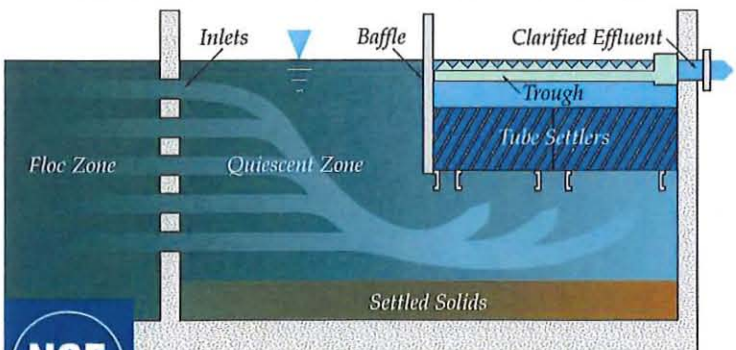
New Jersey-American Water Co.
Tinton Falls, New Jersey

WHY TUBE SETTLERS?

Brentwood tube settlers offer an inexpensive method of upgrading existing water treatment plant clarifiers and sedimentation basins to improve performance. They can also reduce the tankage/footprint required in new installations or improve the performance of existing settling basins by reducing the solids loading on downstream filters.



Tube settlers capture the settleable fine floc that escapes the clarification zone beneath the tube settlers and allows the larger floc formed to travel to the tank bottom in a more settleable form. The tube settler's channel collects solids into a compact mass which promotes the solids to slide down the tube channel.



Made of lightweight, NSF-certified PVC, Brentwood tube settlers can be easily supported with minimal structures that often incorporate the effluent trough supports. They are available in a variety of module sizes and tube lengths to fit any tank geometry, with custom design and engineering offered by Brentwood as well.

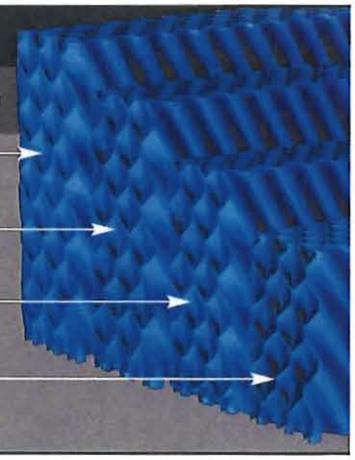
ADVANTAGES OF TUBE SETTLERS

The advantages of tube settlers can be applied to new or existing clarifiers/basins of any size:

- Clarifiers/basins equipped with tube settlers can operate at 2 to 4 times the normal rate of clarifiers/basins without tube settlers.
- It is possible to cut coagulant dosage by up to half while maintaining a lower influent turbidity to the treatment plant filters.
- Less filter backwashing equates to significant operating cost savings for both water and electricity.
- New installations using tube settlers can be designed smaller because of increased flow capability.
- Flow of existing water treatment plants can be increased through the addition of tube settlers.
- Tube settlers increase allowable flow capacity by expanding settling capacity and increasing the solids removal rate in settling tanks.

6000-SERIES

TUBE SETTLER	VERTICAL HEIGHT	TUBE LENGTH	DESIGN APPLICATION RATE
IFR-6041	41″ (104 cm)	47″ (119 cm)	3.5 gpm/ft² (8.5 m/hr)
IFR-6036	36″ (91 cm)	42″ (107 cm)	3.0 gpm/ft² (7.3 m/hr)
IFR-6030	30″ (76 cm)	35″ (89 cm)	2.5 gpm/ft² (6.1 m/hr)
IFR-6024	24″ (61cm)	28″ (71 cm)	2.0 gpm/ft² (4.9 m/hr)



COMPLETE TUBE SETTLER SYSTEMS

Brentwood provides complete engineered tube settler systems, including tube settlers, supports, baffles, troughs & weirs, and protective surface grating. The advantages of a Brentwood installation are:

- **Single source responsibility.** Avoid problems with coordination of engineering, installation, and pricing of different components.
- **Save money** by purchasing an economical, packaged system.
- **Exclusive products and features,** like AccuGrid Protective Surface Grating and integrated structural ribs, provide unique benefits to the tube settler system.
- **Extensive engineering experience** in both plastics design and water treatment technologies are utilized in every system we design.

NSF Certified to ANSI/NSF 61

BRENTWOOD INDUSTRIES

Brentwood Industries, Inc.
Mailing Address P.O. Box 605, Reading, PA 19603, USA
Shipping Address 610 Morgantown Rd., Reading, PA 19611
Phone 610.236.1100 *Fax* 610.736.1280
Email wwsales@brentwoodindustries.com
Website www.BrentwoodProcess.com

 Printed 1/09

DESIGNED AND MANUFACTURED IN THE USA

BDP INDUSTRIES
www.bdpindustries.com

Rotary Drum Thickener

The **RDT** is a simple, time-proven design for thickening sludge in a compact footprint:

- **Reduce digester volume**
- **Minimize liquid hauling costs**
- **Pre-thicken ahead of dewatering**

Industry Leader in Design and Manufacture of Thickening, Dewatering, and Composting Systems.

Rotary Drum Thickener

Unique in the Industry

- Fully stainless steel, tubular frame construction
- Drum composed of 5 to 10 thickening zones with customizable drainage media for each zone
- Drainage media available as stainless steel or polyester fabric
- Easily removable large side panels with lifting handles
- Lower inspection covers are hinged for ease of access to the enclosure
- Automatic & Continuous – Designed to operate without operator attention
- Fully enclosed for odor control and reduced cleanup
- Internally baffled design eliminates short-circuiting and maximizes contact time with drainage media
- Drainage rates easily observed for each Thickening Zone, allowing the operator to optimize polymer dosage and solids capture
- The Initial Thickening Zone is sealed to provide flocculation time and maximum solids capture
- Filtrate Recycle option available to reduce water usage and filtrate flow
- Adjustable angle, self-cleaning shower cleans the drainage media during each revolution

Centershaft / Disc Assembly:

Supported by a cam follower bearing assembly on one end

and by a gearbox drive assembly on the other.

This arrangement keeps the bearing from being exposed to the process.

Optimized Filtration

Variable speed allows the operator to increase or decrease retention time in the rotary drum thickening zones, controlling the discharge solids content with a minimal polymer dosage and maximized solids capture. The internally baffled design allows the unit to handle very high hydraulic loads without flow short-circuiting through the drum. The internal discs are specially designed to handle debris without plugging or ragging.

When higher throughput is required, BDP offers a Dual Drum design, with two drums operating in parallel, inside the same enclosure, with common feed and discharge. Dual Drum design provides redundancy in one unit, allowing one drum to operate while maintenance is performed on the other drum.

Originally designed in 1978, the Rotary Drum Thickener from BDP Industries is constantly improved with valuable feedback from Operations and Maintenance staff. Hundreds of installations have proven their worth, efficiency and reliability on all sludge types. Rotary Drum Elements are made in 3' and 4' diameters and lengths up to 10'.

Filtrate Through Drum Media

P.O. Box 118, 354 State Route 29
Greenwich, NY 12834
T: 518-695-6851 F: 518-695-5417

BDP INDUSTRIES

www.bdpindustries.com

Manufacturer of Dewatering Systems

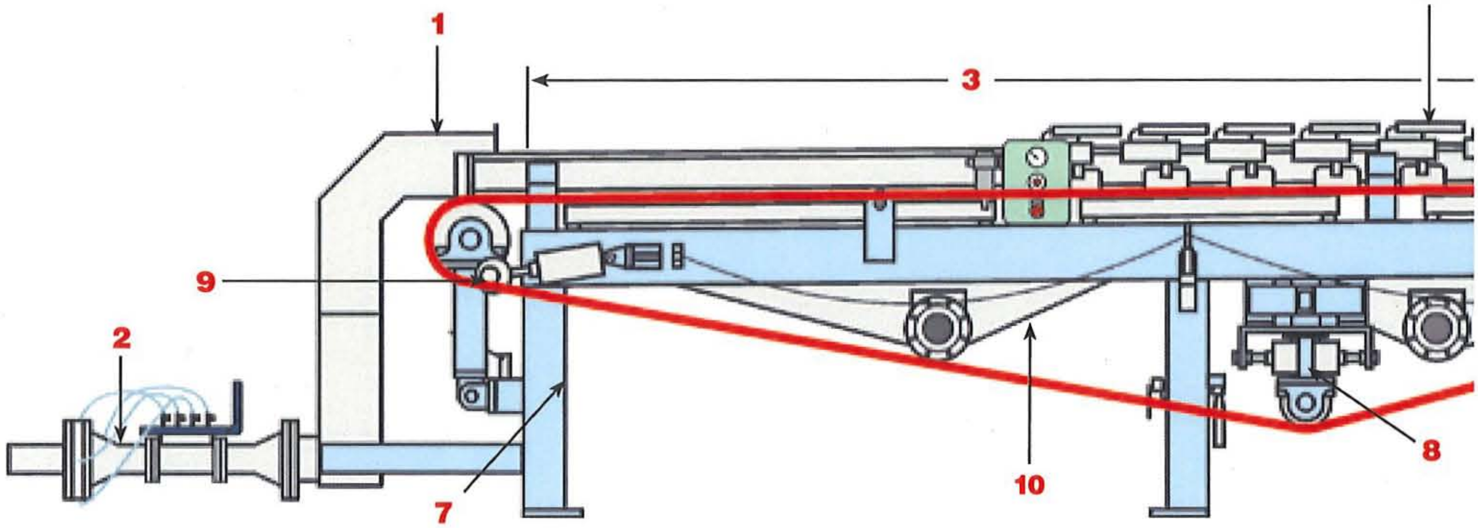
GBT™- Gravity Belt Thickener
and Rotary Drum Concentrator

www.bdpindustries.com

Industry Leader in Design and Manufacture of Filtration Equipment

Superior sludge thickening

– simple, reliable operation.



Design Features

1 Feed Box: Upflow smooth full width weir configuration. Dissipates flow energy, provides retention time for flocculation and insures extremely even slurry distribution so vital to maximizing slurry thickening.

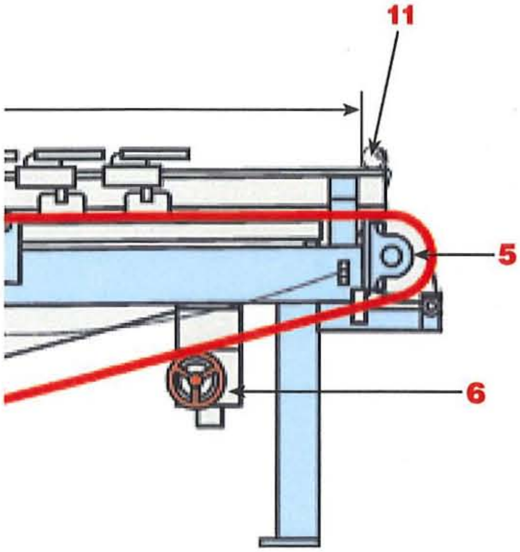
Venturi Mixer

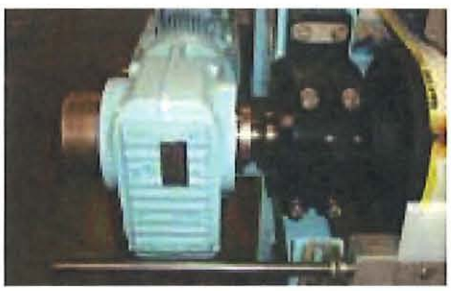
2 Venturi Mixer: Polymer is injected through (4) tangential inlets in the "injection ring" up steam of the "venturi and counterweighted orifice plate".

3 Gravity Deck: (above)
Plastic belt supporting slide strips are easily removed with no disassembly of deckles, Apex curvature along centerline of belt eliminates belt wrinkling. Foil configuration of each slide effectively removes filtrate improving sludge thickening.

4 Adjustable Angle Plows: The adjustable angle allows for maximizing the furrowing action as the sludge thickens.

Adjustable Angle Plows





5 Belt Drive: Capable of varying output speed from 8 to 100 feet per minute, a right angle gear reducer / electric motor with speed control through a control panel mounted "Variable Frequency Controller".

6 Belt Washing: Spray header is mounted inside stainless steel enclosure, eliminating misting. Spray nozzles are internally cleaned and flushed by hand wheel operated wire brush and valve assembly.

7 Tubular Steel Frame: Significantly easier to keep clean. Extremely high moment of inertia (bending and radial inertia 3 to 10 times that of competitors') Hot dipped galvanized inside and out. Precision machined bearing and cross member mounting pads for accurate bearing, roll and frame alignment.

8 Belt Tracking: Tracking systems are available in both pneumatic and hydraulic systems providing trouble free operation. Tracking systems offer smooth and continous tracking without excessive movement.

9 Belt Tensioning: The belt tensioning is adjustable to automatically maintain proper tension. Swing arm assembly provides uniform tension across the full width of the belt. Controls are located on the frame for ease of operation.

10 Collection Pans: Extremely rugged heavy gauge stainless steel collection pans are provided to keep filtrate from falling on filter belt, tracking and tensioning assemblies, to prevent blinding/fouling of these critical components.

11 Thickening Sludge Dam: Adjustable height sludge dam provides additional dewatering to optimize sludge thickening.

GBT™ – Gravity Belt Thickener

Unique Features and How they Work

The Gravity Belt Thickener is used to thicken sludge prior to centrifuge or digestion processes. A mix of primary or secondary sludge can easily be thickened to +7% wt, pure secondary to over 5%.

The GBT offers:

- *High unit capacity per floor space*
- *Low residence time eliminates septicity and float scum*
- *Superior thickening*
- *Low maintenance and simple, reliable operation.*

Venturi Mixer: Provides excellent dispersion of flocculent. The adjustable counter-weighted baffle allows efficient optimization of slurry flocculation for shortened drainage time.

Feed Distribution: The up-flow smooth, full width, weir design provides necessary time for optimum flocc growth and dissipates the feed pipe velocity so the flocc isn't sheared. Slurry is distributed very uniformily across the entire width, regardless of feed consistency.

Gravity Deck: The GBT delivers the largest filtration area per meter of belt width in the industry providing high efficiency thickening and cost effective chemical utilization.

Furrowing Plows: The combination Foil Doctor and adjustable angle plows provide two times the liquid removal of the conventional plow designs of our competitors. The floating mount minimizes filter media wear.

References: Will be provided from over 100 installations. Request appropriate process list and confirm for yourself unmatched process performance and reliability.

Rugged Durable Construction: Tubular construction, hot dip galvanized coating, highest structural moment of inertia, most wetted components, feed box, drainage pans, etc are constructed of stainless steel and all other wetted components are of suitable materials, plastic etc, to provide maximum corrosion protection and construction that will last the life of the facility.

New Plow Design

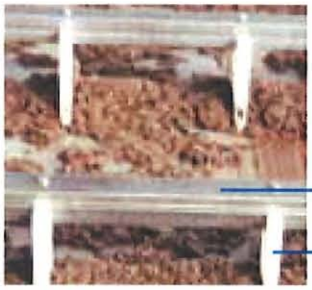
The Foil Doctor® Plow represents a new breakthrough in dewatering technology. The basic concept behind any plow design is to furrow deposited solids on the surface of the filter cloth to expose filter cloth so filtrate can go through with less resistance to flow.

The foil design enhances this short circuiting action by lifting the deposited solids across the full belt width. This action, coupled with the incorporated plows just ahead of the foil, creates a compressive force on the slurry that further enhances dewatering.

The Foil Doctor blade assembly floats on the surface of the filter cloth. Because the assembly floats, as the Foil Doctor assembly wears it still maintains optimum contact. With the conventional furrowing design, wear usually results in a smearing of sludge aggrevating clogging of the filter cloth. Testing has found that one Foil Doctor Plow assembly is equivalent in thickening action to two conventional furrowing plow assemblies.

Significantly thickened slurry coming over Foil Doctor Plow.

Sludge in compression, filtrate being expressed from slurry.

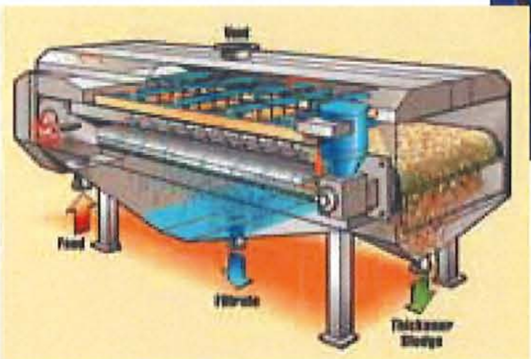


Metal cross support

Vertical plastic supports for Foil Doctor Plow

The Totally Enclosed GBT

With more stringent air quality restrictions, it has become necessary to limit the quantity of air associated with the GBT operation, thus enters the BDP's Totally Enclosed unit. The design incorporates a monolith frame constructed from stainless steel plates cut with the state of the art "Water Jet" plate cutting center. Belt drive, bearings and other components are mounted outside the enclosure for ease of maintenance.



The design encloses the feed distribution assembly, gravity deck, filtrate collection pan and thickened cake discharge. Units are available in width from 0.5 meter to 4 meter. The enclosed GBT can be provide with manual or automatic tensioning and tracking depending on the owners preference.

RDT *as an* Alternative *to a* GBT

– when space is limited or requirements are less demanding.

The RDT offers:

- ***Lower space requirement and lower capital cost than a GBT.***
- ***Minimal operator attention.***

Each Rotary Drum Element is composed of five stainless steel discs supported off a center shaft. The shaft rotates in externally mounted bearings, to prevent contamination from the slurry.


Filtrate Drips into Stainless Steel Drip Pan

Slurry is conveyed through the RDC with a spiral screw assembly attached to the five discs. Filter cloth is wrapped around the perimeter of the five discs and held in place with stainless steel bands; forming the rotary drum. Feed enters the RDC from an overflow weir tank/ launder assembly.

Filtrate is collected in a stainless steel drip pan below the rotary drum.

Thickened slurry flows out the open end of the Rotary Drum and down a chute deflecting it away from the filtrate pan. A shaft mounted gear reducer motor and torque arm drives the rotary drum on the outboard center shaft. A Variable Frequency Controller controls rotating speed of the drum.

An adjustable angle, self-cleaning shower cleans the filter cloth during each revolution.

Rotary Drum Elements are made in 3' and 4' diameters and lengths up to 10'.


Slurry Discharge


Cloth Shower

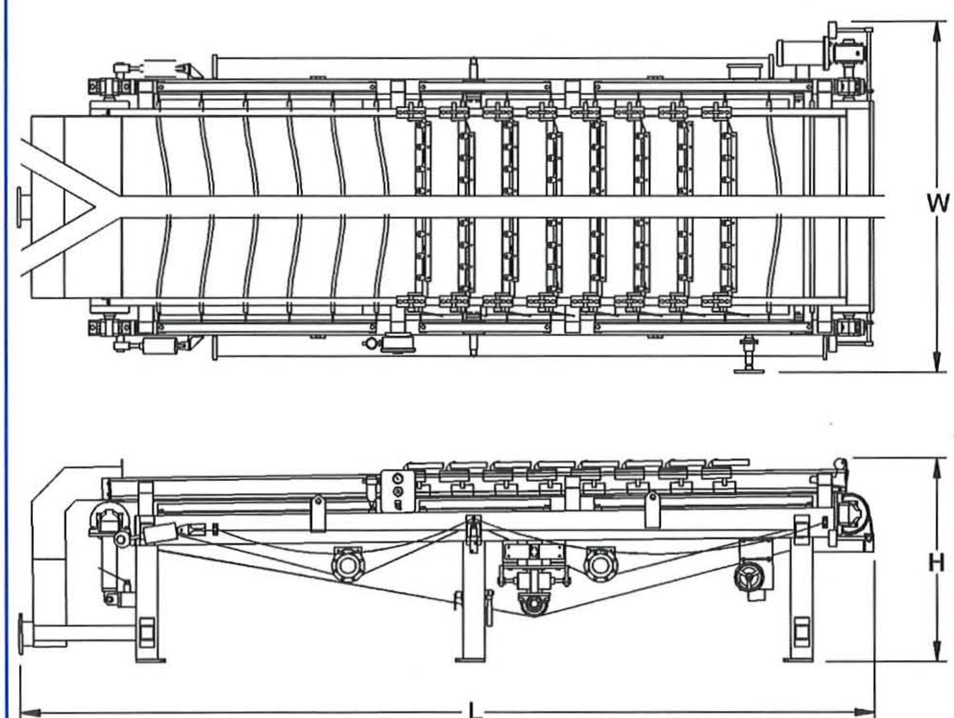
If higher through put is required two drums can be operated in parallel with a common feed and discharge.

Typical Performance Results

GBT Belt Filter Press

Type of Sludge	Feed Conc. WT%	Thickened Discharge Conc. WT%		Loading Rate gpm/m Belt Width		Sludge Volume Reduction, %	
		RDT	GBT	RDT 4'x8' Drum Prop. to dia. and length	GBT gpm/m	RDT	GBT
Waste Activated Sludge	0.5 - 0.9	3.5 - 4.5	5 - 7	100 - 150	200 - 300	75 - 80	85 - 95
Primary	3 - 5	5 - 10	8 - 15	40 - 70	60 - 100	45 - 75	60 - 80
Primary/WAS	0.8 - 2	5 - 8	6 - 11	80 - 130	130 - 200	75 - 80	85 - 90
Pulp & Paper	There are too many types of slurries for this industry to generalize. BDP Industries has many iinstallations. Please call factory for details.						

*** The representative performance values in the table can fluctuate substantially and are provided only for estimating purposes.**



BDP GBT Gravity Belt Thickener Data

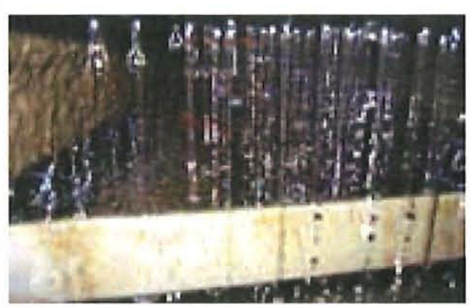
Size (m)		Overall Approx. Dimensions inches (mm) Length	Width	Height	Operating Weight lbs (kg)	Belt Width m
0.5	CP	180 (4,572)	60 (1,524)	54 (1,372)	4,000 (1,814)	0.6
0.75	CP	180 (4,572)	70 (1,778)	54 (1,372)	5,000 (2,268)	0.9
1.0	CP	180 (4,572)	80 (2,032)	54 (1,372)	6,000 (2,722)	1.2
1.0	XP	232 (5,893)	87 (2,210)	55 (1,397)	7,500 (3,402)	1.2
1.5	XP	232 (5,893)	107 (2,718)	55 (1,397)	8,500 (3,856)	1.7
2.0	XP	232 (5,893)	127 (3,226)	55 (1,397)	9,600 (4,355)	2.2
2.5	XP	232 (5,893)	147 (3,734)	55 (1,397)	10,800 (4,899)	2.7
3.0	XP	232 (5,893)	167 (4,242)	55 (1,397)	12,000 (5,443)	3.2
4.0	XP	238 (6,045)	207 (5,258)	57 (1,448)	21,000 (9,525)	4.2

*** Custom sizes and designs available upon request**

4.0 m Gravity Belt Thickener

Rotary Drum Thickener

Totally Enclosed GBT



Filtrate

A Leader in Solids Dewatering.

BDP Industries is an OEM supplier of solids dewatering equipment for several prestigious Fortune 500 companies. With a 40,000 sq. ft. manufacturing facility and the most hands on experience in the industry, BDP has evolved into one of the most modern and complete solids dewatering suppliers in the world.

BDP Industries produces a range of high quality products and services:

- Gravity Belt Thickeners
- Belt Presses
- Screw Presses
- Rotary Drum Concentrators
- Lime Stabilization Systems
- Polymer Systems
- Compost Turning Equipment
- Pulp & Paper Stock Thickeners
- Plate & Frame Presses
- Conveyors
- Process Control Panels
- Equipment Restoration
- On-Site Service
- Mobile Dewatering Demonstrations

BDP INDUSTRIES

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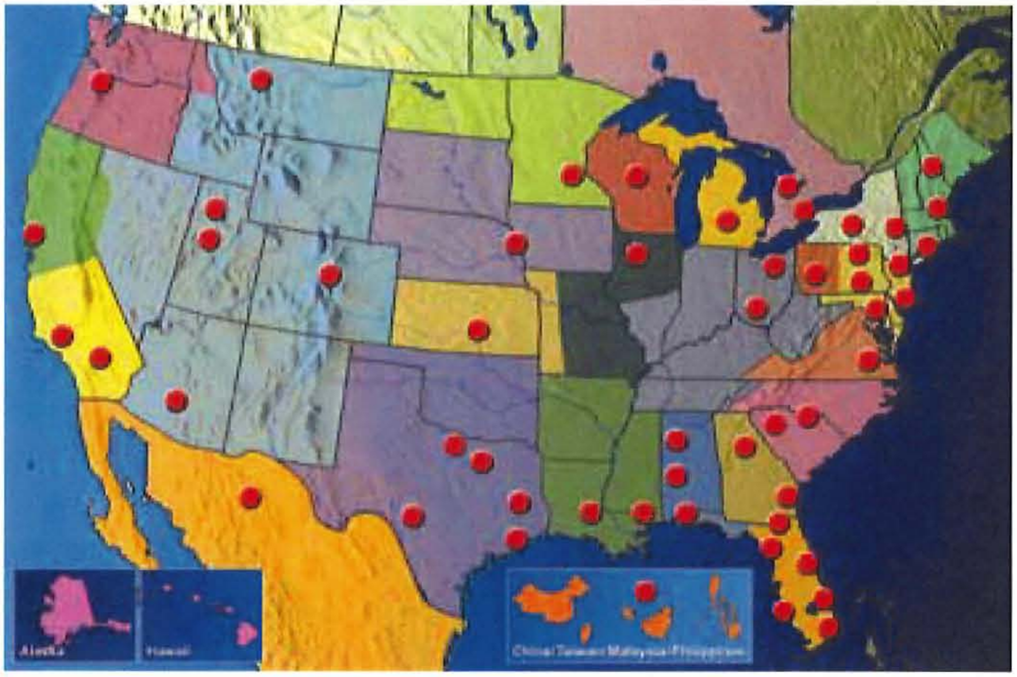
Greenwich, NY 12834
TEL: (518) 695-6851
FAX: (518) 695-5417

www.bdpindustries.com

We're located near you.



Your local BDP representative:

GEA ecoforce™ waterMaster™

Better Technology That Pays for Itself

engineering for
a better world

gea.com

So advanced we call it GEA waterMaster™

The latest generation of centrifugal decanters from GEA has evolved from over a century of experience, technological leadership and extensive R&D. We listened to our customers and developed the new GEA **eco**force™ line of decanters – the most flexible, cost-efficient, and robust decanters ever designed. Whether treating drinking water or wastewater, dewatering or thickening high solids sludge, these units achieve the highest separation results.

These innovative machines were designed to handle the growing complexities facing industrial and municipal customers.

Top issues and challenges of today include:

- Increased demands and complexity of treatment
- Stringent and growing government regulations
- Growing energy and operating costs
- Rising solids disposal costs.

Addressing these issues resulted in our most flexible and responsive equipment yet, with higher throughput, consistently drier solids, and significantly reduced operating costs.

Keeping the future predictable

We know that the demands and complexities of water and wastewater treatment can only continue to grow. To that end, our newest GEA ecoforce™ line of decanters is built in a modular and expandable manner. This allows for responses to changing technologies and environmental conditions with simple adjustments.

And you can be assured that these rugged machines are designed to perform well into the future. Although they operate under extreme conditions, usually 24/7, we have made sure the construction materials will stand up to the job:

- Corrosion-resistant duplex stainless steel
- All process-wetted parts of stainless steel
- Sintered tungsten carbide tile scroll protection.

We are with you for the long haul

Ease of maintenance and our full range of support services from the original manufacturer also promise a long service life. Customers can select their level of service in order to calculate and control the total expected cost of maintenance and minimize any machine downtime. Customer support services include:

- Technical advice by industry specialists
- Preventive maintenance service agreements
- Minor and major interval inspections, servicing and overhauls performed by factory-trained mechanics
- Condition monitoring and function testing
- Detailed service reports and documentation
- Original manufacturer's spare parts, available 24/7
- Training of operators and maintenance staff
- Repairs at either East or West Coast locations
- Equipment upgrades
- Loaner and rental equipment
- Trade-ins and reconditioned machines.

Offline or online monitoring from GEA wewatch®

GEA wewatch provides continuous and proactive monitoring and diagnosis of your machines and processes – including bearing condition, resonance, balance, pressure, output, and power consumption -- and alerts you to any deviation from the norm. This is the ultimate in risk-avoidance monitoring to prevent operating faults and increase the productivity of your equipment.

Significant energy savings through product innovations

GEA ecoforce™ decanters are designed to reduce energy consumption by up to 50%, improve dewatering efficiencies up to 10%, and increase throughput capacities up to 50%.

These customer benefits are possible due to the many technical developments and design improvements in this newest decanter generation.

- The very deep ponds, created as a result of our advanced scroll designs, means a 10% increase in dewatering efficiency coupled with up to a 50% decrease in power consumption.
- The high bowl speeds (over 4,000 G-force operation) have achieved dewatering results up to 10% higher than with lower speed technology, with up to 50% higher throughput capacity.

Greater flexibility and a maintenance-friendly drive system

The patented GEA varipond® system allows the decanter to "think for itself" 24/7, responding to changes in the feed conditions.

In the past, it was necessary to stop and modify decanters to achieve a constant discharge concentration. Now, decanters equipped with GEA **varipond®** (variable pond depth control) can adapt to changing feed conditions at full operating speeds, even with highly fluctuating solids concentrations at the inlet. This results in improved thickening and dewatering and a more uniform total solids concentration at the outlet. In automatic mode, the equipment can even operate itself unmanned at night or on weekends to save on labor costs. The GEA **varipond®** feature also results in a reduced load on the digester, which leads to improved, more cost-efficient digester operation.

Our 4-stage high-torque GEA summationdrive™ manages energy consumption and increases the life of the drive.

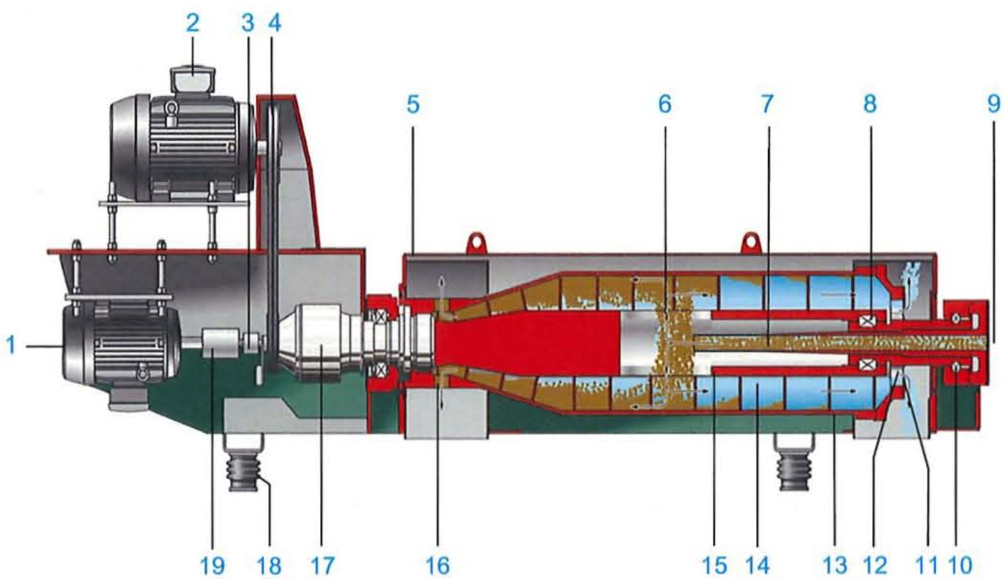
A large differential speed and control range, and constant torque – independent of the differential speed – are achieved by the GEA **summation**drive™ system. The term "summation" refers to the combined energy requirements of the bowl and scroll. Using intelligent kinematics, the two motors precisely deliver only the energy that is required. This eliminates conversion losses due to braking and subsequent recovery. Users can precisely control the torque, even with fluctuating feed conditions, thus ensuring consistent separation with reduced energy consumption

Powerful yet compact

GEA **eco**force™ decanters are available as stationary or mobile units and, though compact, achieve first-class separation results. The compact design increases user options due to the smaller footprint, and decreases shipping costs because of the reduced weight. This modular design allows for future upgrading. Now municipal and industrial users can precisely tailor their investment to their processing needs through our broad range of sizes. As needed, modular skid units are available as mobile units with plug-and-play design and can be quickly transported from one location to another.

Designed for your specific needs

We offer a complete laboratory testing center in Northvale, NJ. Here we can test your sludge to determine polymer conditioning requirements and predict feed rates, cake solids dryness and solids recovery. Should it be necessary to perform full-scale testing, we have completely equipped mobile centrifuge systems that come to you for real world testing and demonstrations.



1 Secondary motor
2 Main motor
3 Scroll drive
4 Bowl drive
5 Frame
6 Distributor
7 Feed Tube

7 Feed Tube
8 Scroll bearings
9 Feed
10 Bowl bearings
11 Regulating plates
12 Gravity discharge of the clarified liquid

13 Bowl
14 Separation chamber
15 Conveyor screw
16 Solids discharge
17 Gearbox
18 Vibration absorbers
19 Coupling

Our GEA service commitment

As an EN ISO 9001 company we stand behind the quality of both our products and our service. Our continuing commitment is to provide customers with the support they need to maximize productivity and minimize downtime. You can count on us for round-the-clock assistance in all service areas.

Original manufacturer's spare parts

We house a large inventory of parts throughout our six office network. These are ready to be shipped out with a 24-hour turn-around. Only genuine GEA parts are manufactured under the same strict quality control and using the same specifications and materials as our original equipment.

Factory-authorized repairs

We offer two full-service repair facilities, one on the West Coast (Patterson, CA) and one on the East Coast (Northvale, NJ). This helps to speed up repair times and keep transportation costs down. Both facilities are factory-certified and are staffed with experienced technicians who have undergone extensive training. If needed, we offer over 100 rental scrolls or bowl assemblies to keep customers up and running while repairs are underway.

Field service

We have an extensive field service team to perform routine and preventive maintenance and to handle any emergencies that may come up. Located throughout North America, these service technicians are strategically positioned in areas where their industry and process-specific knowledge is most valuable. Our service engineers are on call 24/7.

engineering for
a better world

We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.

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BDP INDUSTRIES

Manufacturer of Dewatering Systems

Model 3DP™ Belt Filter Press

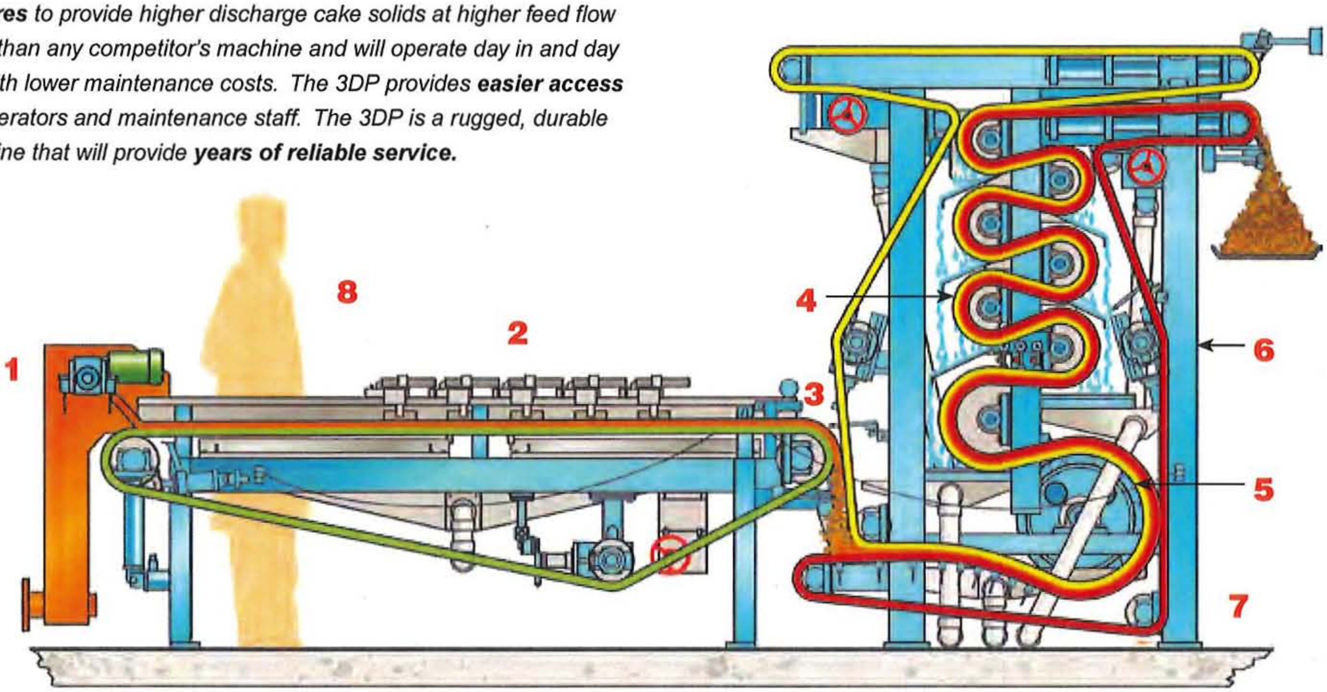
www.bdpindustries.com

Over 25 years of experience in belt press technology

Higher Cake Solids and Feed Rate

— with LOWER Maintenance Costs.

*BDP Industries' **Model 3DP Belt Press** was designed with **unique features** to provide higher discharge cake solids at higher feed flow rates than any competitor's machine and will operate day in and day out with lower maintenance costs. The 3DP provides **easier access** for operators and maintenance staff. The 3DP is a rugged, durable machine that will provide **years of reliable service.***



Design Features

1. **Feed Distributor:** Unique, variable speed paddle wheel provides full belt-width distribution and uniform thickness .

2. **Independent Gravity Zone:** Allows for higher production capacity as well as higher cake solids. ***Available in standard lengths from 6 - 16 ft in 2 ft intervals.***

3. **Spiral Wedge:** Applies increasing cake pressure over the entire length for effective expressing of filtrate with excellent cake retention.

4. **Vertical Pressure Rolls:** Vertical arrangement allows for filtrate pans under each roll to keep filtrate from falling on adjacent rolls. This eliminates reabsorbtion of filtrate and improves discharge cake solids. Discharge height adequate for conveyor without raising press. ***Up to 12 pressure rolls are available.***

5. **Perforated Roll:** Unique design and stainless steel construction improves dewatering and structural strength of roll.

6. **Tubular Frame Construction:** Provides superior structural strength over channel and I-beam construction. Enhanced cleanliness. Hot-dip galvanized coating inside and out affords maximum corrosion resistance. ***Also available in stainless steel.***

7. **Machined Mounting Pads:** All bearing and structural bolted connections are machined, tapped pads which are welded to frame. This enhances structural strength and corrosion resistance.

8. **Overall Layout:** Gravity zone and controls located at operator level simplifies process optimization and eliminates costly platforms.

Unique Features and How They Work

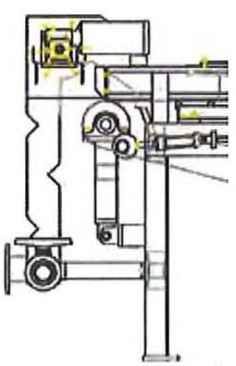
Standard two belt technology employed by most manufacturers forces a compromise in either through-put capacity or discharge cake solid concentration, because belt speed in the two zones must be the same. Three belt technology used by BDP overcomes this limitation by allowing independent speed control in each zone.

In addition significant improvements in feed distribution, wedge zone pressure gradation and effectiveness and elimination of filtrate pooling/rewetting in the pressure zone *MAXIMIZES PERFORMANCE.* The unique low profile gravity zone, tubular steel frame, machined mounting pads for bearings, and bolted connections all provide easier access for maintenance. In photo at right: notice the unique layout and lack of platforms, allowing easy access for maintenance.

The unique designs of the Gravity and Pressure Zones provide MAXIMUM PERFORMANCE.

3DP Belt Filter Press

Upflow Adjustable Speed Paddle Wheel Feed Box



This unique design produces extremely uniform slurry distribution. Sludge enters horizontally at floor level, then transitions to vertical in the upflow conditioning tank and spreads to full belt width. Then the slurry overflows the vertical tank into the paddle wheel distributor weir trough. The adjustable speed paddle wheel pushes the slurry out of the weir trough onto the belt.

Pictured (at right) is 3.5% concentration anaerobically digested sludge; notice the even, full width distribution immediately upon leaving the feed distributor.

Feed box side view

Paddle wheel

Uniform slurry distribution

Model 3DP Belt Filter Press

Independent Gravity Zone

The Model 3DP improves solids loading rate and cake solids with "Independent Gravity Zone Technology".

Conventional two-belt press designs use a gravity zone and pressure zone with a common belt fabric and drive. Belt speed and belt fabric porosity selections are compromised in an attempt to suit both gravity zone thickening and pressure zone dewatering, reducing effectiveness.

BDP has solved this problem.

The 3DP "Independent Gravity Zone Technology" uses separate gravity and pressure zones. This allows "optimizing" the porosity of the belt fabric and belt speed for the gravity and pressure zones rather than being forced to make a trade-off as explained below.

By increasing belt speed through the gravity zone, a thinner cake is applied to the belt. Resistance to filtrate flow is reduced exponentially as cake thickness is reduced. More filtrate is removed, less volume is sent to the pressure zone.

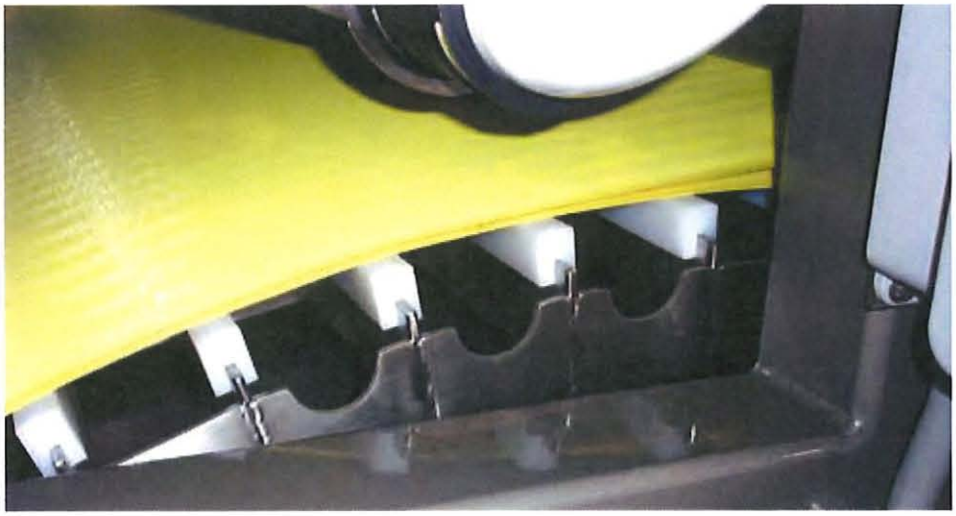
Filtrate removal in the pressure zone increases as the length of time cake is under pressure increases. The independent drive and reduced volume allow the pressure zone belt speed to be reduced for optimal filtrate removal.

Result: The Model 3DP provides higher hydraulic throughput and cake solids.

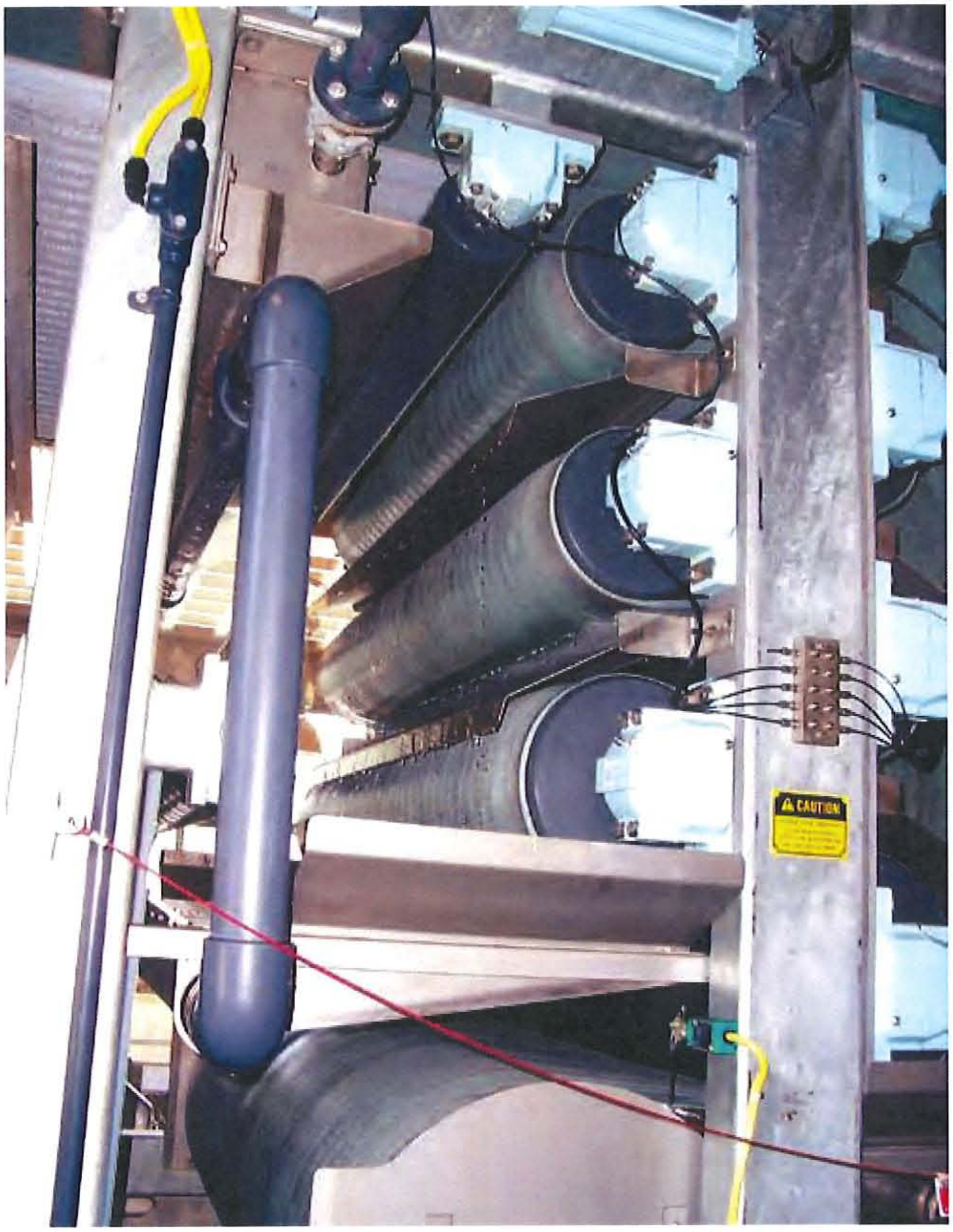
Independent Gravity Zone

Spiral Wedge

The problem with existing wedge layouts is that the top belt doesn't contact and apply pressure to the cake until typically 2/3 of the way through the zone. By curving the wedge profile the top belt immediately pressurizes the cake making the entire length of the zone effective. In addition, the spiral profile provides a gradual increase in pressure through the zone and forces an encapsulation of the cake to resist extrusion out the side.



Spiral Wedge



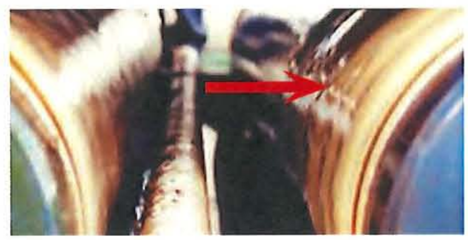
Vertical Pressure Zone

Vertical Pressure Zone

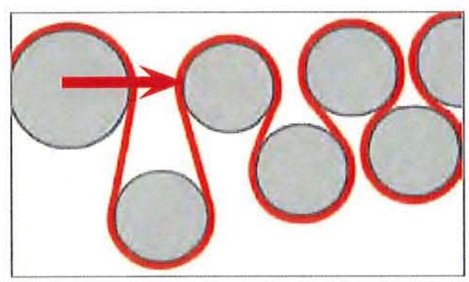
There is no pressure on the filter cake between tangent points of adjacent rolls in the pressure section of a belt press. Therefore, in a horizontal pressure roll configuration, filtrate expressed by each roll runs down the filter cloth to the lower roll and is reabsorbed *(pictured below)* decreasing discharge cake solids.

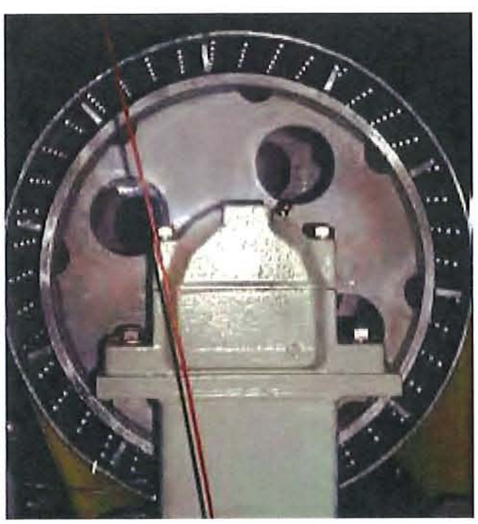
BDP has the answer.

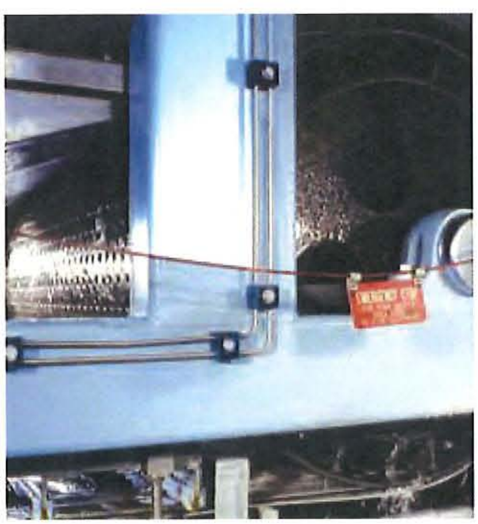
With the the Vertical configuration of the Pressure Zone in the model 3DP, *(shown left)* filtrate expressed at each roll drips from the tangent point into a diversion pan; eliminating rewetting.



BDP's vertical arrangement eliminates the problem of filtrate running off upper rolls and pooling around lower rolls.







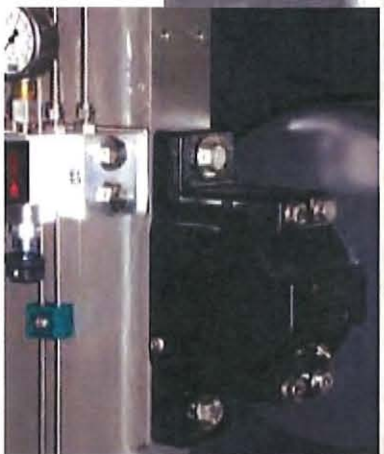
Perforated Roll

Superior Perforated Roll Construction

The highest frequency of roll failures for belt presses is the perforated roll. Typical construction of perforated rolls makes them susceptible to stress fatigue failure of the steel shell where it is welded to inner stiffening rings. BDP Industries' design eliminates the potential for shell failure as the stress load is carried by a solid inner roll. This revolutionary design is the strongest in the industry.

Model 3DP Belt Filter Press

Frame Construction



Channel or I-Beam frame construction are problematic in that corners and ledges are created that are difficult to clean. The tubular frame of the 3DP model provide a flat easy to clean surface.

All bearings are mounted on machined pads welded to the fabricated frame. These pad are precision machined and drilled and tapped for installation of all bearings and bolted frame components.

With channel or I beam, the frame is drilled and weakened at every mounting point. The 3DP frame, on the other hand, is strengthened by tubular steel and machine mounted bearing pads.

Vent holes are strategically placed so that when the frame is hot dip galvanized, it is coated inside and out.

Bottom line: The Model 3DP is stronger, more corrosion resistant, and easier to clean than other machines.

Machined Mounting Pads/Tubular Steel Frame

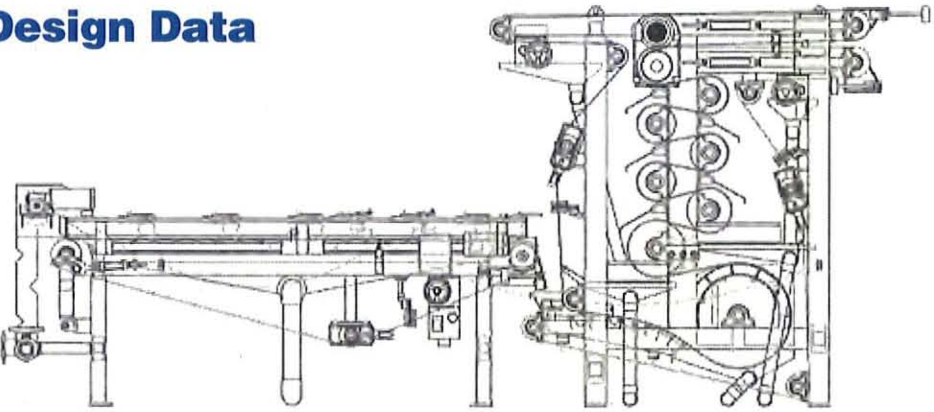
Overall Layout

Most other belt press designs require the belt press to be elevated due to the low cake discharge point. This requires costly platforms to provide observation of the feed distributor and gravity zone *(see below)*.

The layout of the model 3DP allows for gravity zone and controls to be located at operator level. This simplifies the process and eliminates platforms *(see right)*.

Model 3DP Belt Press

Design Data



Typical Performance Results

Municipal Sludge Dewatering Spectrum for 3DP

Sludge Type	Feed Consistency	Solid Loading Rate	Cake Dryness	Polymer Consumption
	%	lbs/hr, m	%	lbs/dt
Aerobically Digested	1 - 3	600 - 900	17 - 22	12 - 18
Waste Activated	.7 - 1.5	600 - 900	16 - 20	10 - 15
Anaerobically Digested	2 - 5	900 - 1500	18 - 25	8 - 12
Primary + WAS	3 - 5	900 - 1800	18 - 27	6 - 10
Primary + WAS + RBC	3 - 5	1000 - 2000	20 - 27	10 - 18
Primary + WAS +Trickling Filter	3 - 5	1000 - 2200	22 - 28	10 - 16
Primary + RBC	4 - 6	1200 - 2500	22 - 30	8 - 15
Primary + Trickling Filter	4 - 6	1200 - 2500	24 - 30	6 - 14
Raw Primary	4 - 8	2500 - 3500	28 - 35	3 - 5
SBR	1 - 1.5	600 - 800	15 - 18	10 - 15
MBR	.8 - 1	500 - 700	15 - 18	10 - 15

*** Polymer consumption is based on 100 percent active ingredients**

Because influents, processes and operation vary greatly, processing results have a wide range.
The ratio of blends will also have an impact on dewatering. The above represent the ranges that might be expected.

3DP Machine Data

Size	Overall Approx. Dimensions inches (mm)			Operating Weight	Belt Width
m	Length	Width	Height	lbs (kg)	m
0.5	258 (6,553)	60 (1,524)	98 (2,489)	7,500 (3,400)	0.6
0.75	258 (6,553)	70 (1,778)	98 (2,489)	9,000 (4,082)	0.9
1.0	258 (6,553)	80 (2,032)	105 (2,667)	12,500 (5,670)	1.2
1.5	276 (7,010)	100 (2,540)	118 (2,997)	19,000 (8,618)	1.7
2.0	290 (7,366)	120 (3,048)	120 (3,048)	23,000 (10,433)	2.2
2.5	290 (7,366)	140 (3,556)	126 (3,200)	27,000 (12,247)	2.7
3.0	290 (7,366)	164 (4,165)	132 (3,353)	35,000 (15,876)	3.2

*** Custom sizes and designs available upon request**

3DP Machine Data

Size	Dry Weight	Belt Width	Grav.	Pres.	Feed Box Drive	Belt Wash Water Volume	Pressure	(80psi boost) Motor
m	lb (kg)	m	hp	hp	hp	gpm	psi	hp
0.5	7,000 (3,180)	0.6	1	1	0.33	26	120	5
0.75	8,000 (3.630)	0.9	1	2	0.33	42	120	7.5
1	9,700 (4,400)	1.2	1	2	0.33	53	120	7.5
1.5	17,300 (7.855)	1.7	2	3	0.33	75	120	10
2.0	24,000 (10,900)	2.2	3	5	0.33	98	120	10
2.5	28,000 (12,715)	2.7	5	7.5	0.33	120	120	15
3.0	36,300 (16,480)	3.2	5	10	0.33	142	120	15

Note: These numbers are preliminary only and based on 10ft long gravity zone.

A Leader in Solids Dewatering.

BDP Industries began fabricating equipment over 25 years ago. BDP is an OEM supplier of solids dewatering equipment for several prestigious Fortune 500 companies. With over 650 installations throughout the world, and a 40,000 square-foot manufacturing facility, BDP Industries has evolved into one of the most modern and complete solids dewatering suppliers in the world.

BDP Industries produces a range of high quality products and services:

- Gravity Belt Thickeners
- Belt Presses
- Screw Presses
- Rotary Drum Concentrators
- Lime Stabilization Systems
- Polymer Systems
- Compost Turning Equipment
- Pulp & Paper Stock Thickeners
- Plate & Frame Presses
- Conveyors
- Process Control Panels
- Equipment Restoration
- On-Site Service
- Mobile Dewatering Demonstrations

BDP INDUSTRIES

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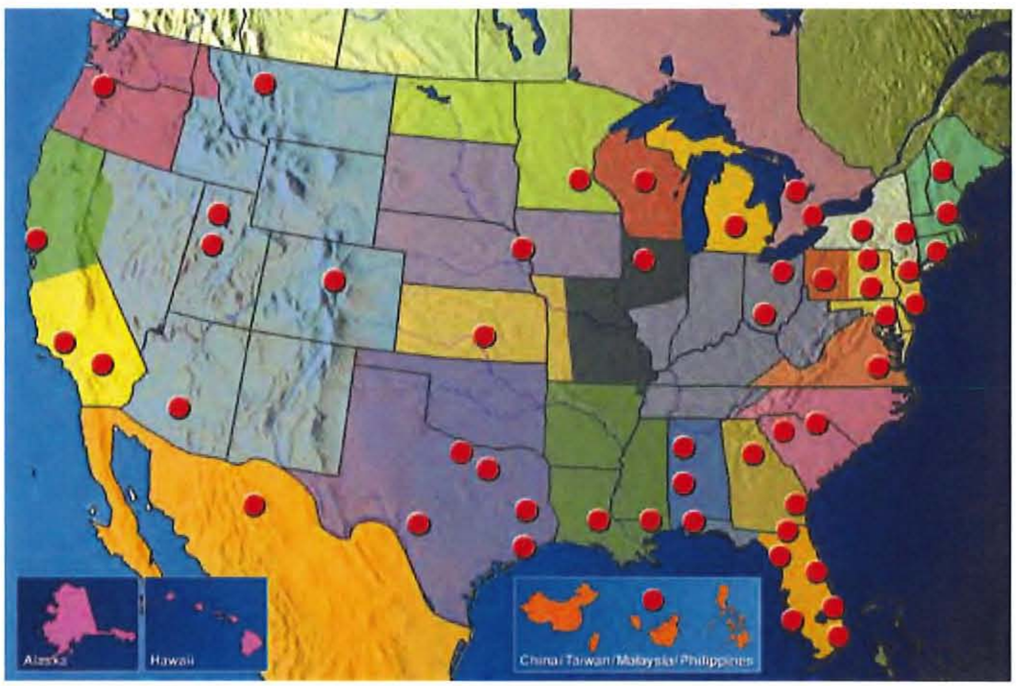
1.5m 3DP mobile trailer unit

We're located near you.



Your local BDP representative:

NETZSCH Pumps North America, LLC
Exton, PA. 19341

NETZSCH

Technical Pump Quotation

Check us out

NM063BY01L07V

Quote:	CD-022752
Date:	1/22/2018
Project:	Erie Water, Blowdown

Product:		***Content***	***nominal***	***minimum***	***maximum***
Name / Composition			Waste Water		
Product temperature	assumed	°F	ambient		
Specific gravity	assumed		1		
Particle size	assumed	mm			<12.5
pH value	assumed		neutral		
Solids content (w/w)	assumed	%TS			<5
Dynamic viscosity		CPS	Not Given		

"Materials of construction are only recommended based on the information provided. Customer needs to verify materials will be compatible with the process fluid or application."

Application details:		***Content***			***maximum***
Flow rate (Q)	approx.	GPM			150.0
Differential pressure	approx.	PSI			25
Suction pressure	assumed	PSI			Flooded
Discharge pressure	approx.	PSI			25
Pump operating speed	approx.	RPM			289
Sliding velocity	approx.	ft./s			4.8
Frequency	approx.	Hz			60
Power required at drive shaft	approx.	HP			3.6
Running torque	approx.	ft./lbs.			64.8
Starting torque	approx.	ft./lbs.			114.7

Assembly specification	Installation:	Horizontal

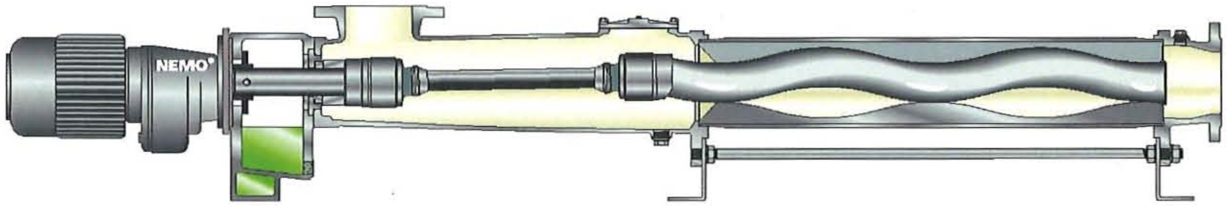
General operating conditions	
Installation area	Inside
Ambient Temperature	Approx. 20°C / 70 F
Humidity	up to 75%
Application type	Continuous operation
Operating hours per day	8
Service voltage	3ph, 60hz, 230/460V

Painting	Coating system	NIL System I RAL 7031 NETZSCH gray NCS 355B60G teal (stator only)

Operating and Maintenance Instructions

Standard documentation in accordance with the 98/37/EG Machinery Directive.
Special documentation is available on request and would be charged for.
Download the Operating and Maintenance Instructions and cover document for each of
your specific pumps at www.NETZSCHusa.com/OM
You may use this new conveniently located tool as often as you like.
Paper copies are still available at a cost of $25.00 per manual.

Pump: NM063BY01L07V



Picture is for reference only and may not be exact model specified

Characteristics and benefits of the NEMO® BY Block pump:

Reliable and sophisticated construction

Space-saving construction

Modular construction system

4 different stator – rotor geometries available for most sizes

Low investment and operating costs

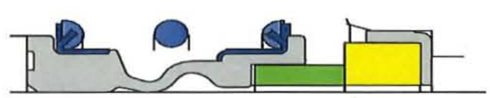
Low maintenance expenses

General characteristics	
name plate on the pump	in English (Stainless steel)
direction of rotation	To the left, counter clockwise(as viewed from drive end)

Pump Pedestal	Cast Iron

Pump housing / End connection	
Housing material	Cast Iron
Housing Connection position	Vertically Upwards (as viewed from drive end)
Function of housing connection	Suction Connection
Function of end connection	Discharge Connection
Suction Connection design	Standard
Nom. dia. & pressure for pump housing	6" 125# ANSI Flange
Discharge Connection design	standard
Nom. dia. & pressure of discharge flange	4" 125# ANSI Flange
Housing seals	FKM

Shaft seal	
Design	Single Mechanical Seal
Shaft seal type	Eagle-Burgmann MG1-G60
Shaft seal materials	SiC v SiC faces, Viton Elastomers, 316SS hardware - Q1Q1VGG



Rotating parts	
Rotating parts materials	AISI 420 - Chrome Steel

Rev - 10/23/2017

Joints	
Joint type	SM Pin Joint with Wear Bushing
Joint sealing material	Buna/316 Stainless Steel
Joint lubrication	Mineral Oil

Rotor	
Rotor material	SAE 4140 VCP - Chrome Plated Steel
Rotor Size	Standard
Temperature range	32-84°F

Stator	
Stator material	NEMOLAST® S61M (Buna)

"Materials of construction are only recommended based on the information provided. Customer needs to verify materials will be compatible with the process fluid or application."

Drive

Premium Efficient Gearmotor	
Manufacturer	Nord
Type	SK672.1F-132SP/4
Flange diameter (mm)	250
Shaft diameter (mm)	40
Cross drill diameter (mm)	14
Cross drill position–measured from IEC face according to WN0146	33
Output speed n2 @60Hz (RPM)	289
Output speed min/max (RPM)	58/289
Gear Ratio	6.12
Mounting position	M1
Power (HP)	7.5
Voltage range (V)	230/460
Frequency (Hz)	60
Min/max frequency (Hz)	12/60
Number of poles / phases	4/3
Motor speed n1 @60Hz (RPM)	1770
Protection type / insulation class	IP55/F

Baseplate:	Carbon steel (top-hat profile)		
Arrangement	Inline		
Options	☐ 4" Grout Holes	☐ Anchor bolts	☐ Casters and handle bar
	☐ Motor mount shims	☐ Lifting lugs	☐ 0.75" Drip Rim w/0.75" NPT drain plug

Approximate Weights – (lbs.)	
Bareshaft Pump	334
Complete Assembly including pump, gear reducer, motor, and baseplate	529

Bredel 65, Bredel 80 and Bredel 100 hose pumps

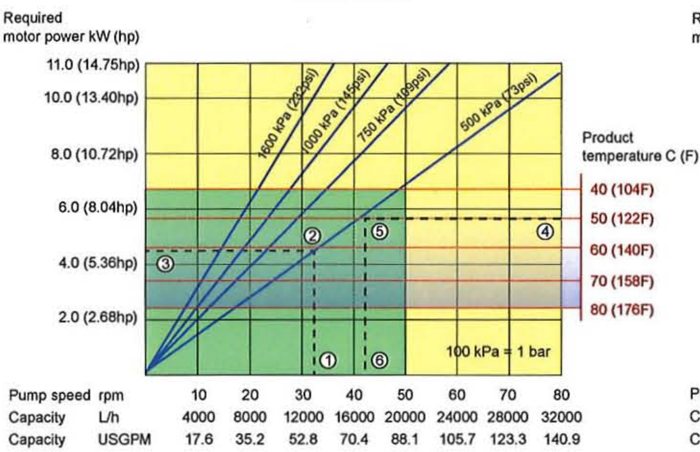
Bredel SERIES
Bredel Hose Pumps

FEATURES AND BENEFITS

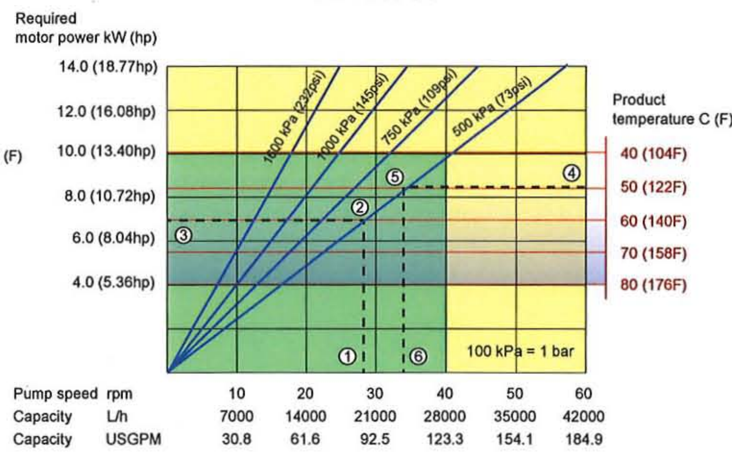
- **Sealless, valveless pumping principle for reliable, low maintenance metering, dosing and transfer**
- **Flow rates up to 53,000 L/hr (233 GPM) and pressures up to 16 bar (232 psi)**
- **Dry running and self-priming, with up to 9.5 meters (30 foot) suction lift capability**
- **Robust design for aggressive chemicals or abrasives**
- **Compact direct coupled design to maximize gearbox life**
- **Simple hose change decreases cost of ownership, downtime and need for parts inventory**

PERFORMANCE

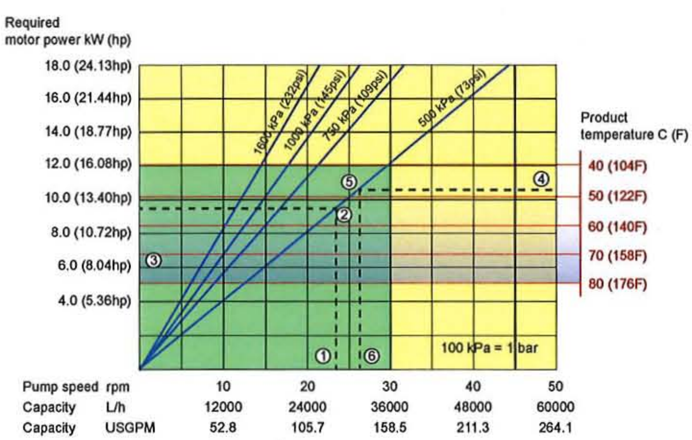
Bredel 65



Bredel 80



Bredel 100



Continuous Duty

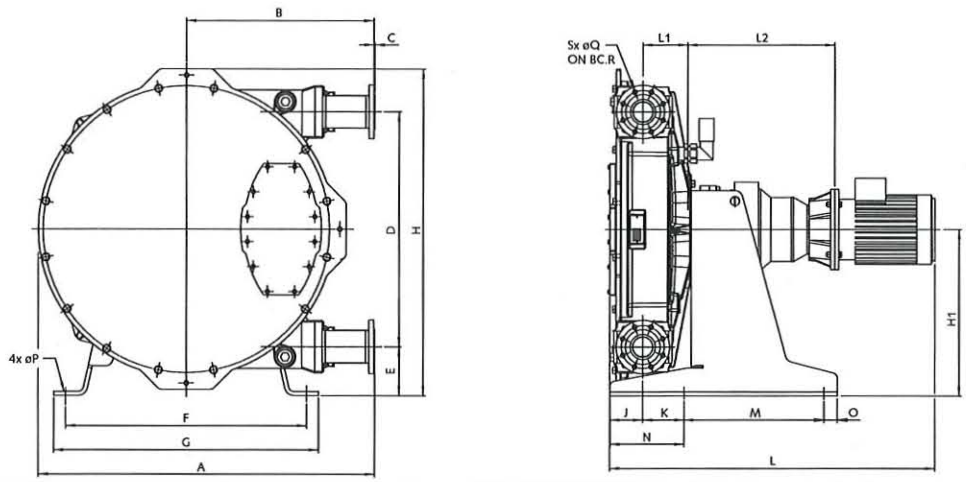
Intermittent Duty*

* Maximum 2 hours operation followed by minimum 1 hour stop

1. Flow required indicates pump speed
2. Calculated discharge pressure
3. Net motor power required
4. Product temperature
5. Calculated discharge pressure
6. Maximum recommended pump speed

Note: The area of continuous operation diminishes with increased product temperatures.
For product temperatures >40C (104F), the area of continuous operation is limited by the corresponding red temperature line.

DIMENSIONS



Type	A	B	C	D	E	F	G	H	H1	J	K	Lmax	L1	L2max	M	N	O	ØP	ØQ	R	S
Bredel 65 (mm)	1059	580	3	746	152	680	740	1036	525	104	137	1172	141	486	415	220	50	18	18	145	4
Bredel 65 (inches)	41.7	22.8	0.12	29.4	6	26.8	29.1	40.8	20.7	4.1	5.4	46.1	5.6	19.1	16.3	8.7	2	0.71	0.71	5.7	0.16
Bredel 80 (mm)	1257	700	4	876	182	900	990	1218	620	124	153	1351	166	582	525	275	50	22	18	160	8
Bredel 80 (inches)	49.5	27.6	0.16	34.5	7.2	35.4	39	48	24.4	4.9	6	53.2	6.5	22.9	20.7	10.8	2	0.9	0.71	6.3	0.31
Bredel 100 (mm)	1468	813	3	1042	199	1050	1140	1415	720	151	173	1392	200	489	540	310	50	22	18	180	8
Bredel 100 (inches)	57.8	32	0.12	41	7.8	41.3	44.9	55.7	28.3	5.9	6.8	54.8	7.9	19.3	21.3	12.2	2	0.9	0.71	7.1	0.31

TECHNICAL SPECIFICATIONS

	Bredel 65	Bredel 80	Bredel 100
Flow range	up to 32,000 L/hr (140.9 GPM)	up to 40,000 L/hr (176.1 GPM)	up to 53,000 L/hr (233.4 GPM)
Capacity	6.7 L/rev (1.77 G/rev)	11.7 L/rev (3.09 G/rev)	20 L/rev (5.28 G/rev)
Minimum starting torque	1,150Nm (10,178 inch-lbs)	2,000Nm (17,701 inch-lbs)	3,100Nm (27,437 inch-lbs)
Hose lubricant required	20 liters (5.28 G)	40 liters (10.57 G)	60 liters (15.85 G)
Pumphead weight	398 kg (877 lbs)	672 kg (1482 lbs)	1032 kg (2275 lbs)
Max inlet pressure	2.0 bar (30 psi)	1.5 bar (23 psi)	
Common features			
Suction pressure	0.05 bar (0.73 psi)		
Maximum discharge pressure	1,600 kPa (16 bar) (232 psi)		
Product temperature range*	-10C up to 80C (14F up to 176F)		
Ambient temperature range**	-20C up to 45C (-4F up to 113F)		

*Please consult your Bredel representative for lower or higher temperature operation.
**Allowable ambient temperature is based on pump capabilities and may be further limited by gearbox ambient capabilities

MATERIALS OF CONSTRUCTION

Components	Materials
Pump housing	Cast iron
Rotor	Cast iron
Pressing shoes	Aluminium or epoxy
Cover	Mild steel
Brackets	Galvanized steel or AISI 316
Flanges	Galvanized steel or AISI 316
Inserts	AISI 316, PVC, PP, PVDF
Support frame	Galvanized steel or AISI 316
Hose clamps	Galvanized steel or AISI 316
Shaft	Alloy steel
Seals	Neoprene or nitrile

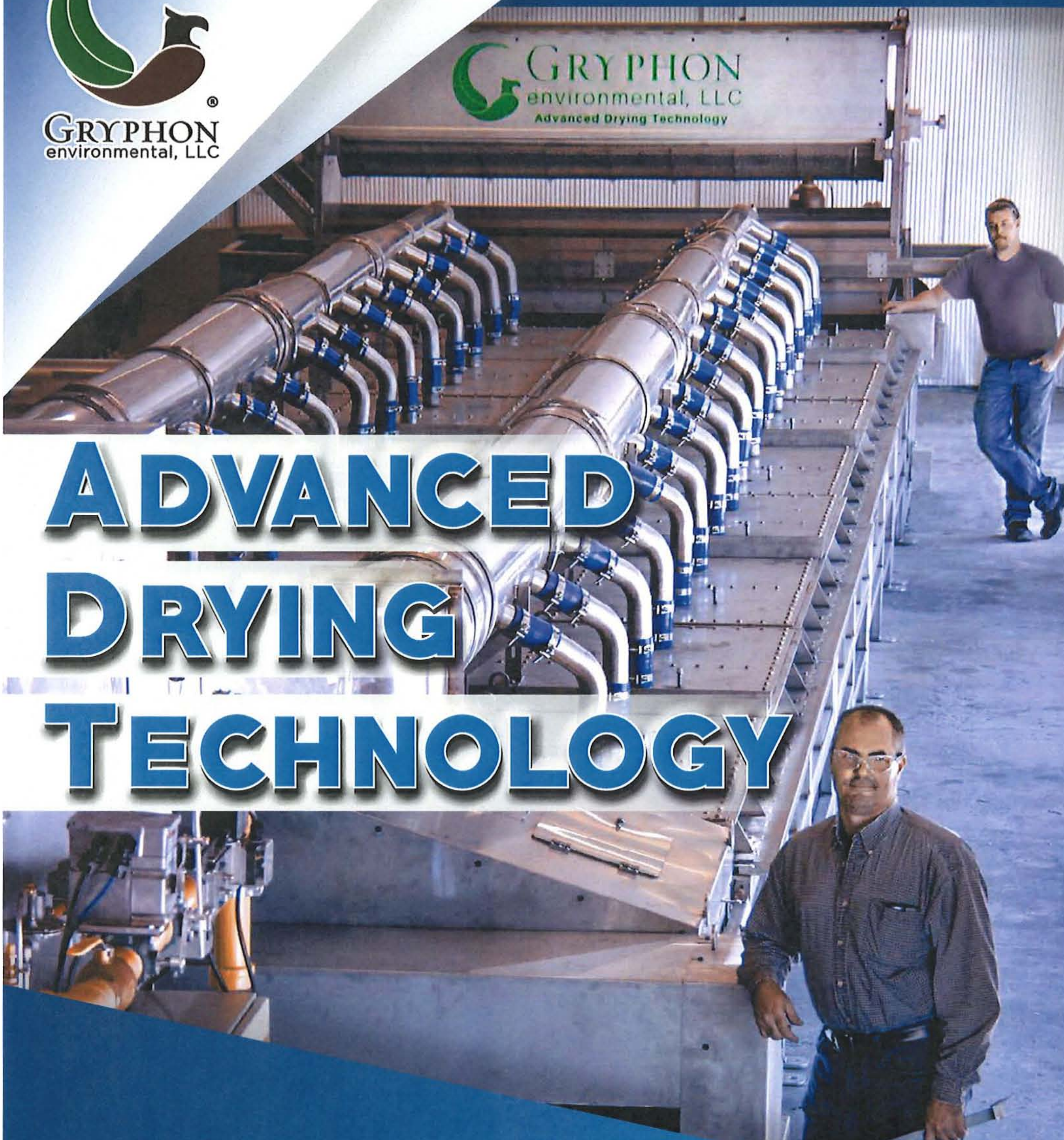
Options	Features
Available hose materials	NR, NBR, F-NBR, EPDM, CSM
Available flanges	ANSI, EN DIN, JIS
Available inserts	Bredel standard or with sanitary connectors
High level float switch	Max. 2A, 230V AC/DC, max. 40VA
Low level float switch	ATEX: max. 50 mA, max. 28V AC/DC
Integrated FI for stand alone speed control	Factory programmable from 12-80 Hz
Revolution counter	For maintenance intervals and/or metering
Vacuum assist	For difficult suction conditions and high viscosity fluids
Cover lifting device	For one-man pump maintenance

Bredel
Hose Pumps

wmpg.com
800-282-8823
support@wmpg.us

AUTOMATED DRYING TECHNOLOGY FOR
APPLICATIONS OF ANY SIZE

GRYPHON®
environmental, LLC



ADVANCED DRYING TECHNOLOGY

MADE IN USA

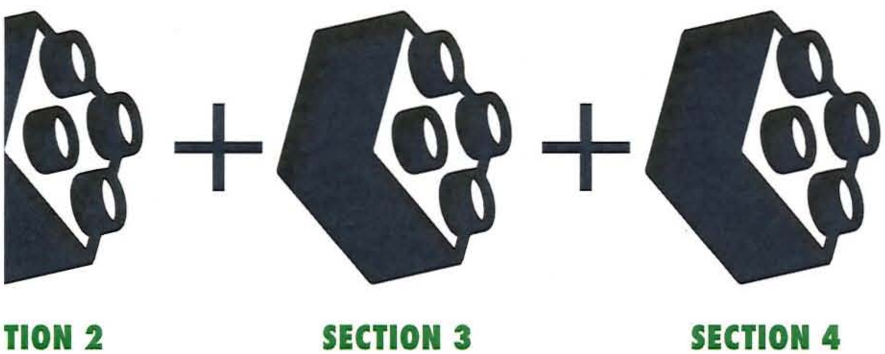
Gryphon Environmental, LLC
2920 Fairview Drive, Owensboro, KY 42303
www.2gryphon.com info@2gryphon.com (270) 485-2680

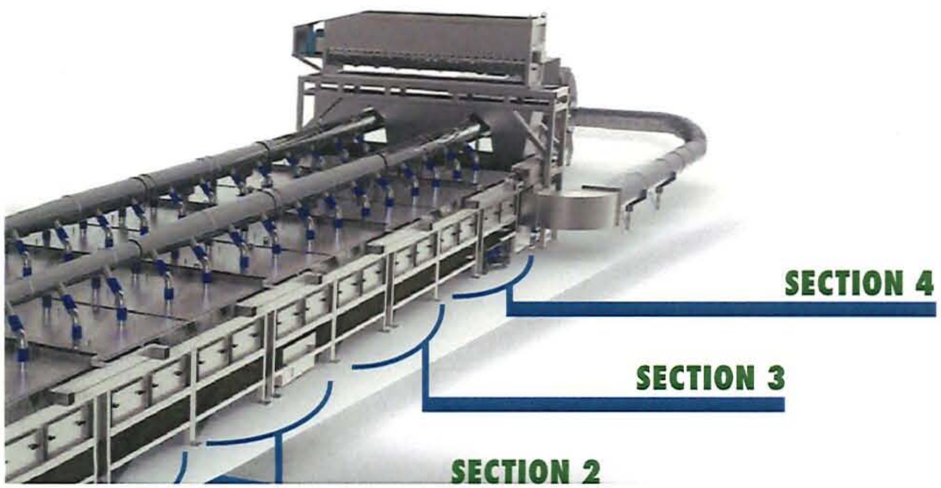
ryphon's sectional dryer esign provides major benefits ı manufacturing, shipment, ıstallation and functional xpandability.

This innovative design reduces capital costs, speeds lead time, simplifies freight methods, reduces installation time and cost and provides flexibility for the future.

꞉EPEATABLE :XPANDABLE)ESIGN

SAVES MONEY





MODEL 03-SERIES

3 ft. by 6 fi

Sections are ɛ models 0312

For municipal Evaporative (of water per d

N

5 ft. by 10 ft.

Sections are assembled in a series to produce models 0510, 0520, and 0530 dryers.

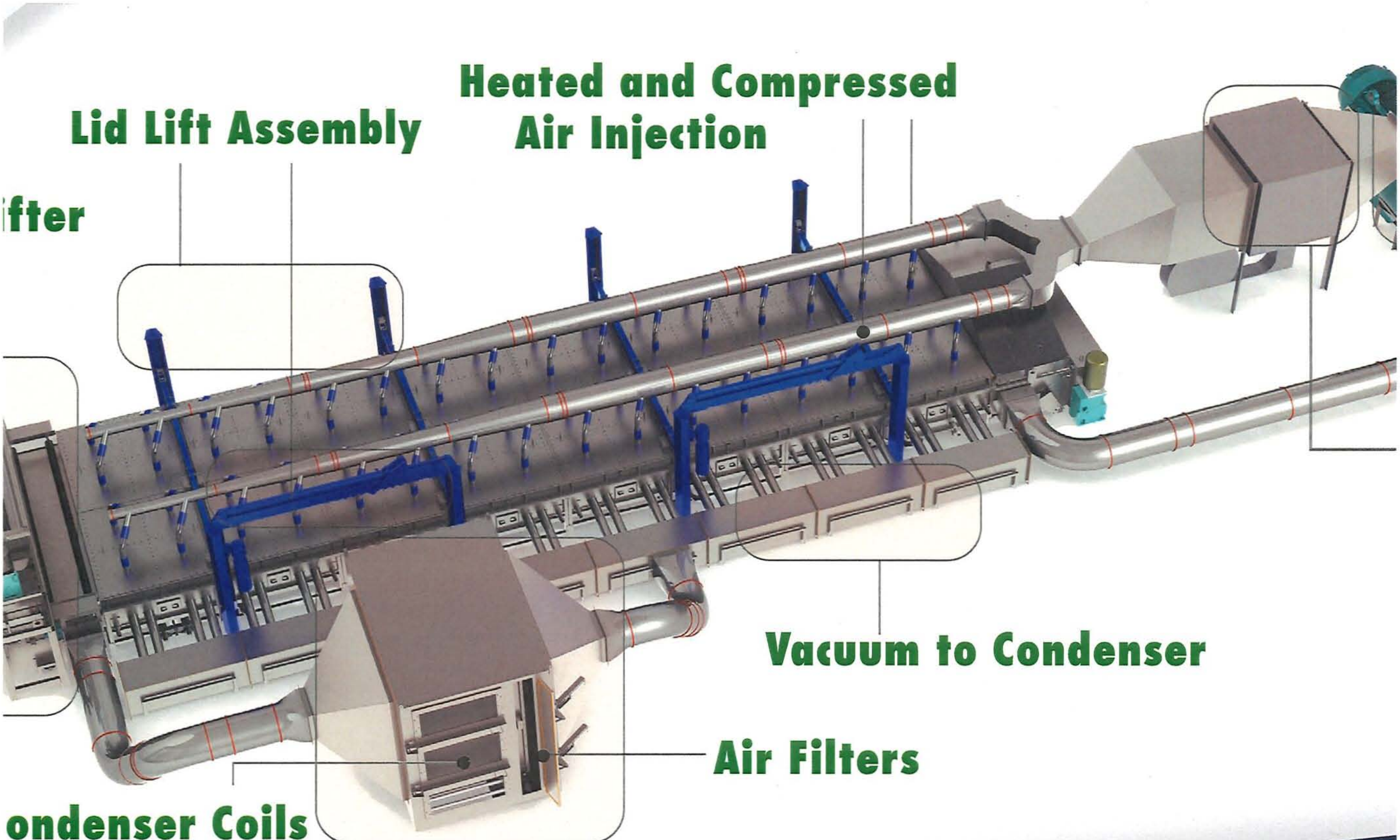
For municipal plants ranging from 3 to 15 MGD. Evaporative capacities range from 5 to 15 tons of water per day.

MODEL 10-SERIES

10 ft. by 1(

Sections are ɛ models 1020, unit designs ɛ point of contı

For municipa MGD. Evapor



and

- Low chamber temperature enhances drying safety.

C controlled
ycle time.

- Advanced thermodynamics reduces energy demands.

FEW MOVING PARTS AND REDUCED MAINTENANCE.

RAPID PRO

INSTALLED

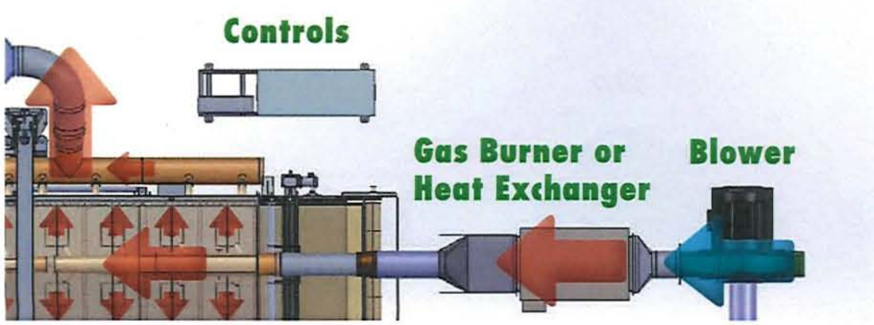
SHIPMENT

ryphon's closed loop design
-circulates more than 90%
f the air stream. In addition
unprecedented energy
fficiency, air re-circulation
ontrols odors and reduces or
liminates the need for air
ermitting.

Heating of the air stream can be achieved by using the most economical energy source. Options include natural gas, biogas, waste heat, steam or electricity.

RE-CIRCULATING AIR STREAM

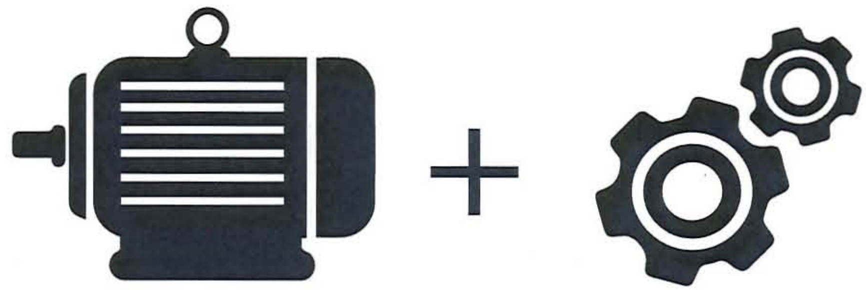
- Lower capital costs
- Reduced power consumption
- Rapid lead time
- Quick and simple installation
- Less ancillary equipment
- Reduced solids handling
- Class A, EQ validation and trend monitoring
- Potential tax incentives



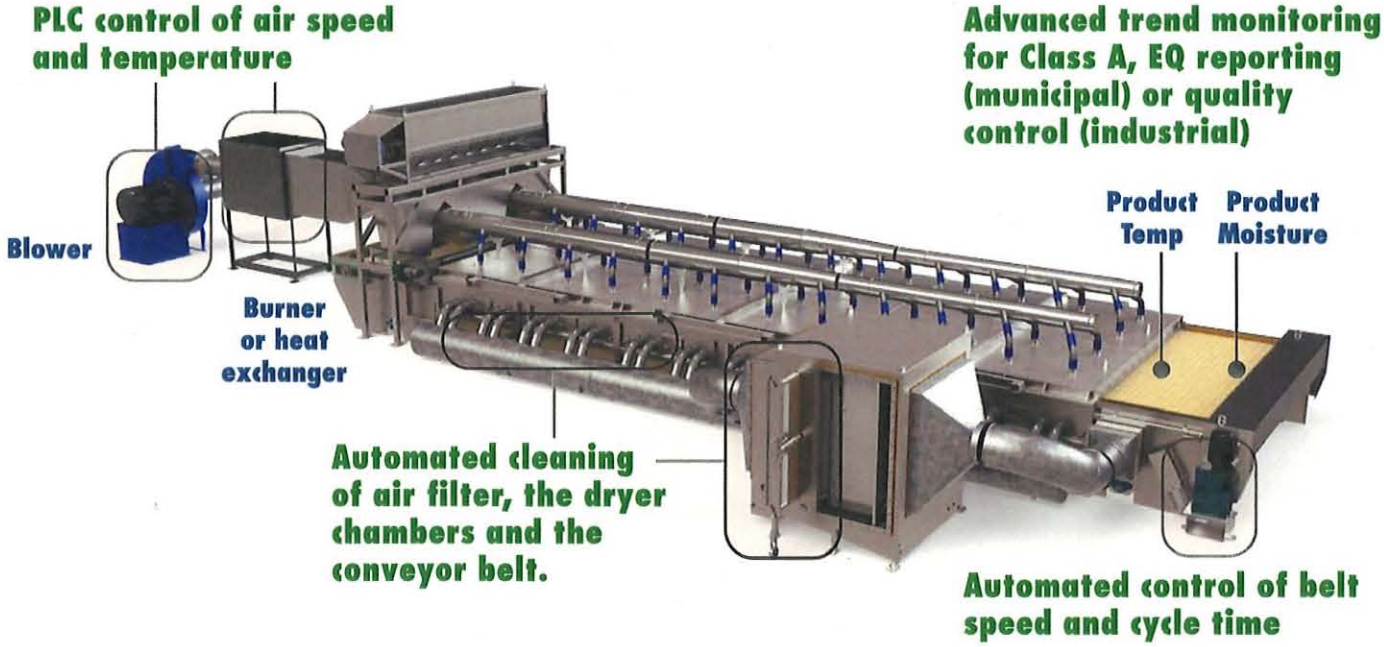
Fewer moving parts means lower maintenance costs and maximum safety. Dryers are engineered for accessibility and built with standard off-the-shelf motors, pumps, drives, controls and instrumentation.

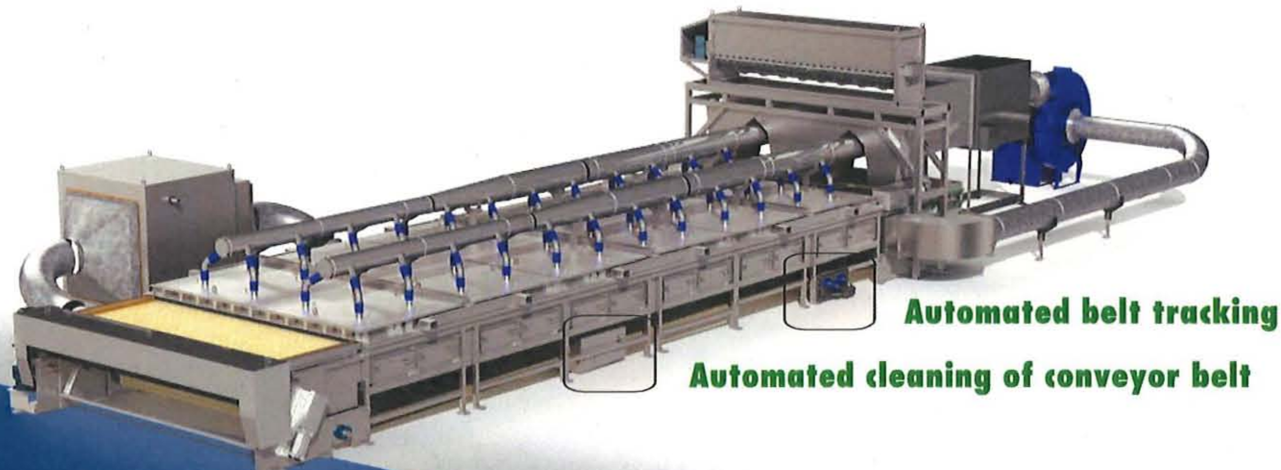
The innovat
maintenanc
maximizes u

MAINTENANCE MA



Comprehensive Trend Monitoring





While advanced PLC software actively monitors and adjusts the drying process in real-time to maintain Class A, EQ bio-solids quality, trend monitoring software also records all critical process variables for complete historical data compliance. Gryphon's triple redundancy approach ensures simplified, worry-free reporting to satisfy US EPA 503 requirements and other regulatory demands.

First method: Specialized sensors measure moisture content of the dried material as discharged from the dryer. Historical data is automatically recorded and available for reporting.

Second method: Temperature sensors measure the dried material at multiple intervals as discharged from the dryer. In addition to moisture content, temperature data serves as a redundant verification that Class A, EQ requirements are met.

Third method: Measurement and recording of product residence time, along with process air mass flow and temperature, provides a third verification of time versus temperature exposure.

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