# EVALUATING AND SELECTING CLASS A BIOSOLIDS HEAT DRYING OPTIONS IN THE PACIFIC NORTHWEST

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## ABSTRACT

The Alderwood Water and Wastewater District (District) is currently in the process of upgrading the Picnic Point Wastewater Treatment Facility (WWTF). This project involves replacement of all liquid and solid stream processes and expansion of the existing 3 mgd plant to 6 mgd while maintaining existing treatment plant operations. The plant will be upgraded from a conventional activated sludge plant with sodium hypochlorite disinfection and belt filter press dewatering producing a Class B product, to a state-of-art plant with membrane bioreactors, UV disinfection, centrifuge dewatering, and heat drying. The facility will not include digestion, and production of Class A biosolids is achieved by heat drying alone.

With the assistance of the Design Consultant, the District selected centrifuges and heat drying as their biosolids management option. The District elected to go through an evaluated bid selection format (including economic and non-economic factors) to select the appropriate drying technology and manufacturer, and then assign the contract to the general contractor. The selection process was divided into four stages to narrow down and select the technology and manufacturer. The first phase involved creation of a Dryer Team to develop and implement a dryer evaluation and selection process. The second phase requested a statement of qualifications from several manufacturers. For the second phase, the manufacturers who submitted were asked to give a presentation for the selection committee. Based on the statement of qualifications and presentations, the Dryer Team (consisting of District and Design Consultant representatives) evaluated five manufacturers, representing four different dryer types:

- Indirect heating of thermal oil with conductive heat transfer
- Indirect heating of circulation air with convective heat transfer; single-pass of solids
- Direct heating of circulation air with convective heat transfer; recycling of solids
- Fluidized bed dryer

The District selected three manufacturers as pre-qualified bidders for the third phase and the Dryer Team developed the comprehensive procurement documents. The selection process included product quality, operations and maintenance considerations, manufacturer's experience, operating parameters, corporate responsibility, risk, reliability, project implementation, and life-cycle costs. The process allowed each manufacturer to propose their drying system according to the performance specifications and include a separate bid item for a dried biosolids conveyance and storage system. Additionally, the manufacturer included a lump sum bid item for design and

consulting services since they would be required to take part in the design process and a lump sum bid item for performance optimization services for a one year period following final acceptance. These contractual terms included requirements for the selected manufacturer to participate in the design process as a member of the design team, and, unlike traditional design approaches, the manufacturer would therefore have a higher stake in the successful outcome of the design and project.

The request for proposals included several forms and a questionnaire to facilitate and streamline the evaluation process, as well as provide an equitable selection process. For the fourth phase, the District evaluated the proposals. Based on the District's scoring of the selection criteria for each proposer, the District ultimately selected Kruger's belt drying system. This belt dryer is currently the first under contract for a municipality in North America.

During the design process, the Design Consultant worked with the local utility company, Puget Sound Energy (PSE), under their conservation grant program to receive funds for upgrading the thermal system with a high efficiency heat exchanger. The high efficiency heat exchanger has an efficiency of 92.7% as compared to only 82% for the conventional heat exchanger. PSE has agreed to provide approximately 70% of the additional cost of upgrading from the conventional to the high efficiency heat exchanger, resulting in a very short payback period.

The Design Consultant investigated different types of dried product conveyance methods, considering site constraints, product characteristics, and dust creation. A pneumatic conveyance system was selected as the best option for this application. The specifications for the dried product system included safety measures for the conveyance, storage, and dust collection system to ensure dried product handling safety.

**KEYWORDS**

Class A biosolids, biosolids heat drying, life-cycle cost analysis, evaluated bid, energy incentive programs, high efficiency heat exchanger, dried product safety, belt dryer, conductive drying, convective drying, direct heating, indirect heating.

## INTRODUCTION

Heat drying of biosolids has historically been popular at medium to large wastewater treatment plants in urban areas of the eastern U.S.A., Canada, and other parts of the world because it reduces the volume of biosolids and produces a higher quality product meeting the EPA's Class A biosolids requirements for pathogens. A Class A product can be used for more applications compared to the conventional Class B product. Due to these benefits and the availability of new types of dryers, heat drying is becoming increasingly common at smaller plants, particularly in the Pacific Northwest. The Northwest has several biosolids dryer installations:

- Friday Harbor, WA
- Burlington, WA
- North Bend, WA
- Sumner, WA
- Pierce County, WA
- Vancouver, WA
- Alderwood Water and Wastewater District, Snohomish County, WA (in construction)
- Myrtle Creek, OR

The Alderwood Water and Wastewater District (District) is located in an urban area of south Snohomish County between the City of Everett and the King/Snohomish County line (north-south boundaries), and the Puget Sound and the City of Mill Creek (east-west boundaries). The District's service area covers approximately 60 square miles, and services an approximate population of 160,000. The District is currently in the process of upgrading the Picnic Point Wastewater Treatment Facility (PPWWTF). The PPWWTF receives and treats approximately 25 percent of the wastewater flow in the District. The upgrade involves the replacement of all liquid and solid stream processes and expansion of the existing three (3) mgd (maximum month flow design capacity) plant to six (6) mgd, while maintaining existing treatment plant operations. The plant will be upgraded from a conventional activated sludge plant with sodium hypochlorite disinfection and belt filter press dewatering (producing a Class B product) to a state-of-the-art plant with membrane bioreactors, UV disinfection, centrifuge dewatering, and heat drying. Class A biosolids will be produced solely by heat drying (the facility will not include digestion). This paper describes types of biosolids dryers available for use at wastewater treatment plants, discusses in detail the evaluation and selection process for a Class A biosolids heat dryer for the PPWWTF, and concludes with a brief discussion of tax and utility incentives that may be applicable to proposed biosolids drying installations.

## BIOSOLIDS DRYING CONSIDERATIONS

Increasingly, wastewater treatment facilities seek to produce Class A biosolids because they have significant benefits over conventional Class B biosolids. Heat-dried Class A biosolids reduce the mass of biosolids by a factor of approximately six because they contain less water. Dewatered cake is approximately seventy-five to eighty-five percent water, whereas heat-dried biosolids have less than ten percent water. Thus, heat-dried biosolids reduce truck traffic in and out of the plant as well as disposal costs by a factor of approximately six. Additionally, heat-dried biosolids are less subject to increasing disposal costs. Landfill costs are rising and landfills are becoming less likely to accept biosolids – for example, the Cedar Hills Landfill in the Seattle area no longer accepts municipal biosolids. Disposal costs of Class B biosolids at composting facilities are also rising.

Social perceptions of Class A and Class B products are changing. Class A biosolids are increasingly being viewed as an asset, either as a nutrient or fuel source. For example, Class A product can be used as a fertilizer, soil amendment, or composting blend because it has fewer land application restrictions[1]. In fact, in some communities, Class A product is a highly desirable fertilizer. As a fuel, a Class A, heat-dried product can be combusted for power or heat generation; recent years have seen a rise in cement kilns interested in using biosolids as a fuel source. All of these beneficial applications have led to a shift in the public's perception of biosolids; in fact, they are frequently viewed as an asset. As both a fuel and fertilizer, the product may provide additional income to the municipality. The dried product market appears to be growing.

In land applications using Class A biosolids, public access to the site is less restrictive, which opens up new areas and makes the product more acceptable to surrounding communities. Class A also contains less putrescible material, which reduces odor and increases public acceptance. These improvements allow for greater market flexibility.

By virtue of the benefits of Class A biosolids, heat dryers are increasingly in demand.

## HEAT DRYING OVERVIEW

Today, many types of dryers are available, providing several options for wastewater agencies. This section provides a general overview of some of the common dryer types.

The terms "convection" and "direct" drying have often been used interchangeably and generally mean drying by circulating hot air around and through the biosolids, typically on a belt or in a drum. Similarly, the terms "conduction" and "indirect" drying have often been synonymous and generally mean drying by circulating a thermal fluid through the walls and central auger. For the purpose of this paper, however, these terms are defined as follows:

- "Convection" and "conduction" relate to the heat transfer in the evaporation process (heat transfer from the heating medium or heating fluid to the biosolids)
- "Direct" and "indirect" relate to heat transfer from the combustion products to the heating medium

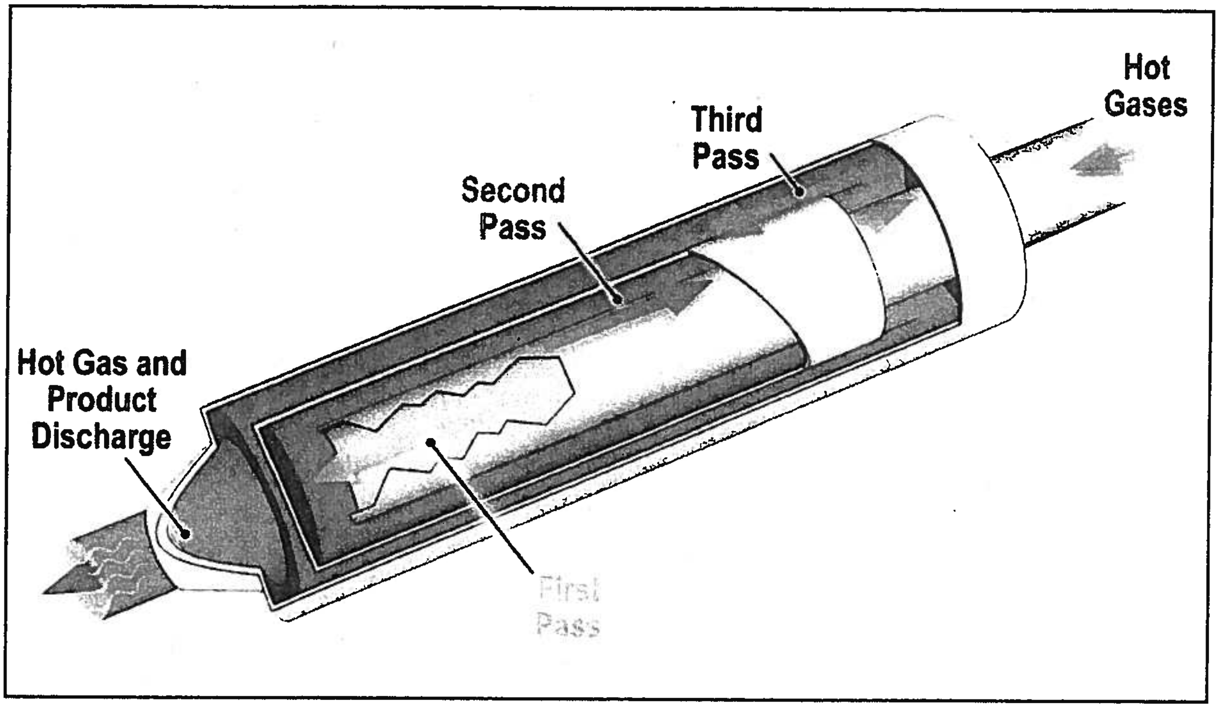
[1] Despite its nutrient value, municipalities should not assume that the final product can be licensed and used as fertilizer. Metals may drive the application rate of a fertilizer and if the metals contents are not within accepted ranges, the dried biosolids may not be suitable as fertilizer. Agronomic metal loading limits may be state dependent and any WWTP should test or review historical test records of metals before considering manufacturing a Class A dried biosolids fertilizer product. The EPA's standard for a Class A, Exceptional Quality product has metal limits concentrations (this differs from the states' *loading rate* limits).

**Convective**

In convective drying, the heating medium (typically air) is in direct contact with the biosolids. The circulation of the heating medium through and around the biosolids evaporates the water. The convective dryer types typically operate on a continuous or flow-through basis (as opposed to batch).

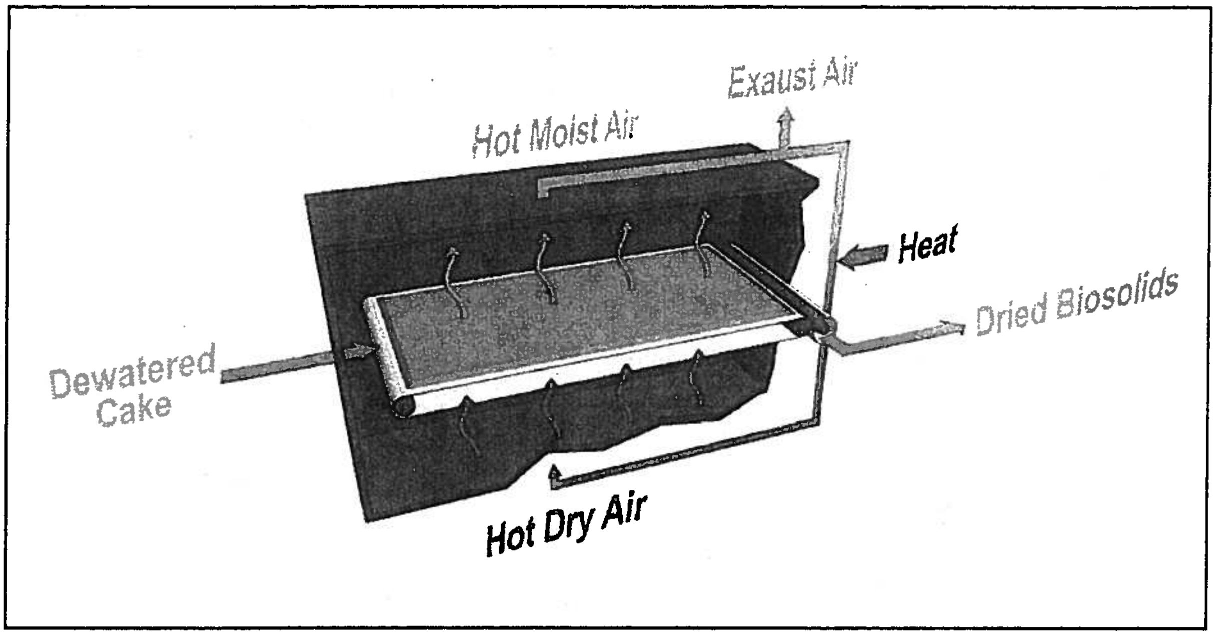
In Figure 1, the heating medium in a drum or rotary dryer also moves the product through the dryer. In this case, the product must be separated from the heating medium in a separate process external to the dryer.

**Figure 1 – Convective Drying in a Rotary Drum**




In Figure 2, the biosolids are spread out on a belt and the heating medium is circulated through the belt and biosolids layer. The circulation air is typically recycled at a rate of seventy to ninety percent. At the end of the belt, the dried biosolids drop on a screw conveyor to remove it from the dryer.

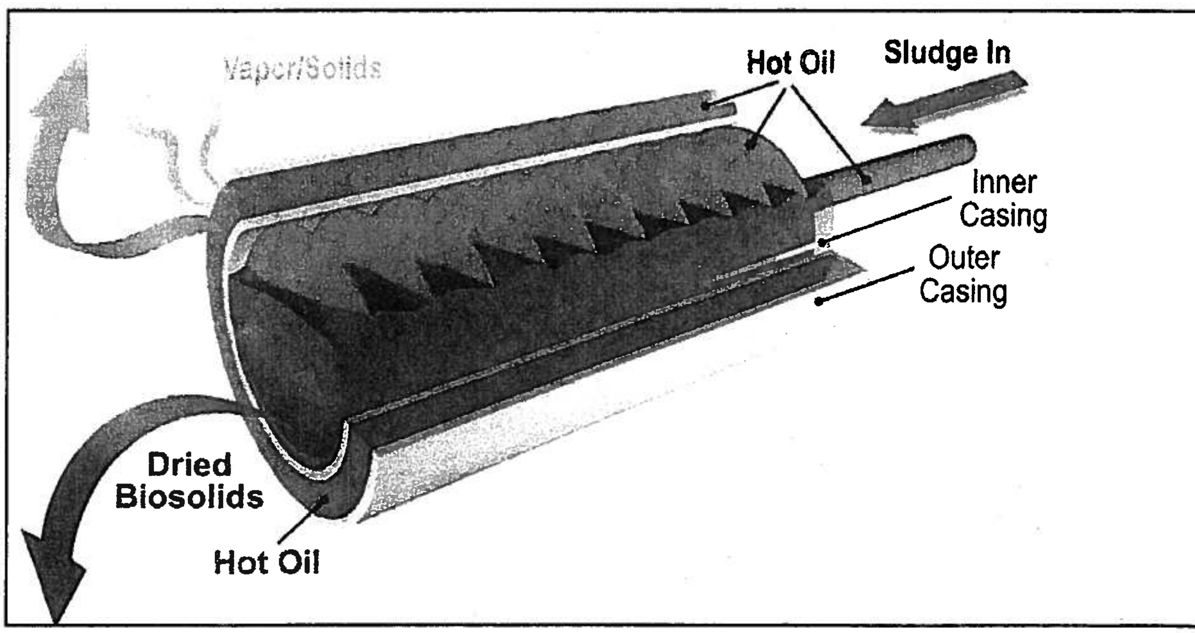
**Figure 2 – Convective Drying in a Belt Dryer**




**Conductive**

In conductive drying, the heating medium (typically a thermal oil, steam, or water) is not in direct contact with the biosolids. The heating medium is circulated through the casing and central auger and transfers heat to the biosolids through the direct contact between the metal and biosolids (see Figure 3). A variety of conduction dryer types are often used, including screw, paddles, disc, tray, and thin film dryers.

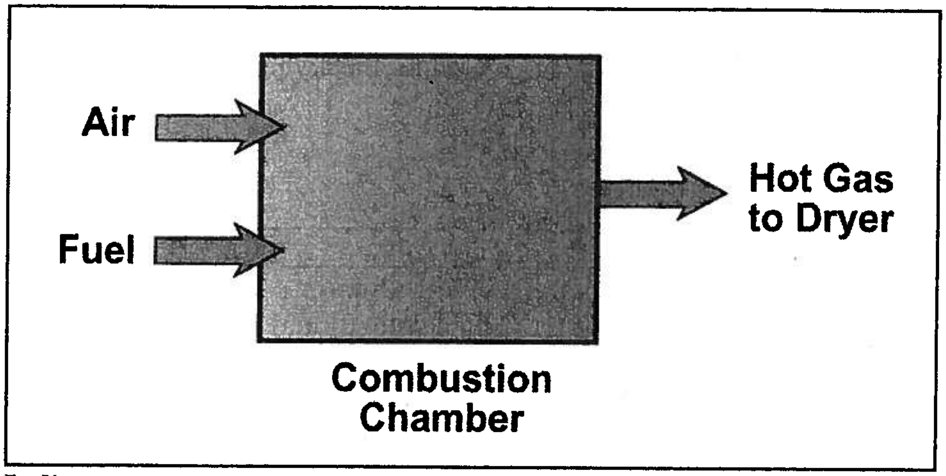
**Figure 3 – Conductive Drying**



**Direct**

In a direct heating process, the combustion gases are sent directly to the dryer and become part of the heating medium (see Figure 4). For example, in the rotary drum types, a combustion chamber precedes the drying chamber and the hot combustion gases are mixed with the biosolids products (see Figure 1). The conductive dryer types do not use direct heating methods. Typically, both rotary drum and belt dryers use the direct heating process.

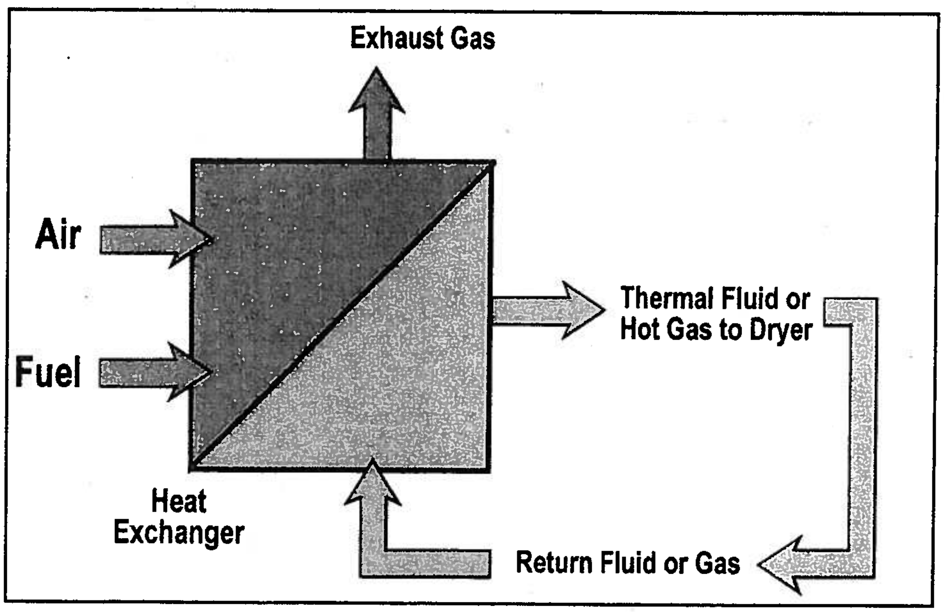
**Figure 4 – Direct Heating Process**




**Indirect**

In an indirect heating process, the heating medium is heated in a heat exchanger or boiler and the combustion gases are vented separately (see Figure 5). Both conductive and convective dryers use indirect heating methods.

**Figure 5 – Indirect Heating Process**



### Hybrids

Not all dryers will neatly fit the categories above and some manufacturers use a combination. For example, fluidized bed dryers use a thermal fluid circulating through a heat exchanger in the fluidized bed and then circulate a gas to create the fluidizing effect; therefore, they use both conductive and convective heat transfers. Since a thermal fluid is used, the fluidized bed dryers are indirectly heated. One manufacturer uses a two-stage drying system with a thin film evaporator to pre-heat the dewatered cake (indirect-conductive) and a belt dryer to complete the drying process (direct-convective or indirect-convective). Table 1 below shows the authors' classification of several available manufacturers according to the categories established above. This classification is based on a review of the literature and the authors understanding of how these dryers operate. Systems listed in Table 1 are often used for the drying of municipal biosolids.

**Table 1 – Biosolids Dryer Manufacturers**

| | Conductive | Convective |
|---|---|---|
| Direct | (NA) | Andritz (drum)<br>Sernagiotto (drum)<br>Kruger (belt)<br>Andritz (belt)<br>Huber (belt) |
| Indirect | Fenton (screw)<br>Komline-Sanderson (paddle)<br>Siemens / US Filter (paddle)<br>Seghers (tray)<br>Stord (disk) | Kruger (belt)<br>Andritz (belt)<br>Huber (belt) |
| Hybrid | Andritz (fluidized bed)<br>InnoPlana (thin film and belt)<br>Schwing (fluidized bed) | |

## BIOSOLIDS DRYING FOR THE ALDERWOOD WATER AND WASTEWATER DISTRICT

### A Case for Implementing a Competitive Dryer Selection during Detailed Design

As noted above, there are several dryer manufacturers in the marketplace. The complexity and diversity of these systems makes the process of technical and economic comparisons between them increasingly difficult. For municipalities that need to follow competitive bidding processes and/or comply with funding agency procurement policies, the selection of even major equipment is often left to the Contractor based on technical specifications. However, in order to prepare a highly biddable installation for a biosolids dryer, a method to equitably compare and select biosolids drying equipment during the detailed design process is needed for biosolids drying equipment. Selection of the equipment allows for more efficient equipment and building layout and minimizes the potential for changes during construction.

### Goals and Objectives

The purpose of the next section of this paper is to illustrate the approach followed by the District to procure a dryer to produce Class A biosolids for the upgrade of its Picnic Point Wastewater Treatment Facility (WWTF). District policy requires competitive bidding procedures be followed. The paper describes the development of the dryer procurement process and the results of its implementation, thereby offering guidance to municipalities that are considering dryer procurement.

### The Procurement Process

The procurement process was implemented as four major steps, which are described below:

***1. Creation of Dryer Team.*** The Biosolids Dryer Procurement Team (Dryer Team) was formed and tasked with developing and implementing the procurement process. The Dryer Team included members of the District staff and the consultant staff. Consultant team members were available for facilitation, presentation of facts and data, and providing their opinions. Only the District representatives selected the preferred dryer manufacturer.

For the District, heat drying was selected as the method to produce a Class A product primarily because it would reduce the amount of biosolids to be managed and corresponding truck traffic in the community, promote environmental sustainability, and create opportunity for beneficial reuse of the dried product. In addition to heat drying, the District selected a centrifuge as their dewatering process, in place of their current belt filter press. This decision was based on a life-cycle cost analysis of a belt press and a centrifuge followed by a biosolids drying. The assumed 2 to 3 percent drier cake from a centrifuge reduced the cost of natural gas for evaporation sufficiently to overcome the additional cost of a centrifuge.

After the District elected to utilize a heat drying process, the next step was to determine the dryer type as well as the method for obtaining the preferred dryer. The Dryer Team discussed at length the various dryer types at several workshops and meetings, and it became clear that there was no particular reason to eliminate any one dryer type. Further, the District did not have a preference for a particular type; instead it was more concerned with obtaining a biosolids dryer that met their cost, operations and maintenance, risk and reliability, and product quality needs.

*2. Request for Statement of Interest/Qualifications and Presentations.* In September 2005, the Board authorized solicitation of a Statement of Interest/Qualifications (SOI/Q) for Dryer Manufacturers. No preferences for drying technology were identified in the solicitation; all types would be considered in the first phase of the evaluation process. Seven manufacturers responded to the advertisement by submitting statements of interest/qualification (SOI/Q). The SOI/Q's provided the Dryer Team with enough information to determine that each dryer was unique and that several of the technologies were unfamiliar to some of the Dryer Team members. All seven manufacturers that submitted an SOQ/I were considered for further evaluation and invited to participate in the second phase of the evaluation process which included a presentation in mid-December 2005.

*3. Request for Proposals from Shortlisted Manufacturers.* Based on the SOI/Q's and presentations, the Dryer Team was able to shortlist three manufacturers based on criteria established in the solicitation. The Dryer Team completed a Request for Proposals (RFP) in early April 2006 and invited the shortlisted manufacturers to respond. Section 5 of the RFP described in detail the proposal requirements including the selection criteria and associated points. Proposals were received from all three shortlisted manufacturers. The proposal evaluation process included interviews.

The RFP specified the following:

(1) General project information (including a project description and overview of the selection and procurement processes)
(2) Scope of equipment and services (outlining the equipment to be provided as well as the manufacturer's services to be provided before, during, and after construction)
(3) Contractual terms with the General Contractor (outlining delivery schedules, payment schedules, and liquidated damages)
(4) Contractual terms with the District (including contract schedule and liquidated damages)
(5) Selection process and proposal requirements (describing the proposal requirements and evaluation criteria)
(6) RFP procedures
(7) Forms

Although most of the above are fairly typical for many RFPs, two areas were somewhat unique or unconventional for the Picnic Point WWTF project – the scope of equipment/services (2), and the selection process and proposal requirements (5).

The District elected, as part of the Scope of Equipment and Services aspect of the RFP, to contractually set up a design process with specific timelines and contractual obligations. Equipment, tools, and spare parts are typically items that are procured or pre-purchased. However, in addition to these items, the District chose to include a performance optimization period and design and consulting services. The performance optimization services include four site visits at two days each by a certified factory representative and must be completed within the first year of operation. The design and consulting services required the manufacturer to take part in the design process. Including the manufacturer in this way produces a better design by facilitating communication and increasing the manufacturer's stake in the outcome. As part of the design process, the manufacturer was required to attend three design meetings with the District and Design Team, as well as two conference calls per month.

Another key contractual obligation for the selected manufacturer was to produce specific submittals prior to key milestones of the design process (see Table 2 below for the submittal requirements at the key milestones). At each step, feedback to the manufacturer would be provided and the subsequent submittal updated based on District comments and preferences and progress of the design.

**Table 2 – Design Submittals**

| *Design Documents* | *60%* | *90%* | *100%* |
|---|---|---|---|
| Process control narratives | ✓ | ✓ | ✓ |
| Process and instrumentation diagrams | ✓ | ✓ | ✓ |
| Heat and materials balance | ✓ | ✓ | ✓ |
| Mechanical drawings | ✓ | ✓ | ✓ |
| Weights | ✓ | ✓ | ✓ |
| Connection and interconnection diagrams and drawings | ✓ | ✓ | ✓ |
| Electrical drawings | ✓ | ✓ | ✓ |
| Quantities and sizes of variable speed drives and solid state starters | ✓ | ✓ | ✓ |
| Instrumentation and control drawings | ✓ | ✓ | ✓ |
| Panel schematics, panel fabrication drawings, and arrangement drawings | NA | ✓ | ✓ |
| Manufacturer cut sheet | ✓ | ✓ | ✓ |
| Installation Instruction Manual | NA | ✓ | ✓ |
| Equipment list | ✓ | ✓ | ✓ |
| Control strategy | ✓ | ✓ | ✓ |
| Additional submittals | ✓ | ✓ | ✓ |

Structuring the submittal process in the above manner facilitates the effective communication of information between the District, consultant team, and manufacturer.

The Selection Process and Proposal Requirements portion of the RFP described the manufacturer selection, and detailed the specific components of the proposal. This streamlined the final selection process and facilitated the evaluation of the proposals. Proposals were required to include the information shown in Table 3. Most of the submittal requirement for Tabs A through I included specific forms developed for this process. Among these forms was a very detailed, 79-item questionnaire that was tailored to address the evaluation criteria established by the District and outlined in Table 3 below.

The process also allowed each manufacturer to propose their drying system according to the performance specifications included in the RFP.

**Table 3 – Content of Proposal**

| *Section* | *Content* |
|---|---|
| - | Cover Letter |
| Tab A | Basic Qualification Criteria Response Form |
| | Unit Responsibility Certification Form |
| Tab B | Contract Price Form |
| | Warranty |
| Tab C | Bonding and Insurance Letters |
| Tab D | Corporate Responsibility Form |
| Tab E | Level of Effort and Key Personnel Resumes |
| | Level of Effort for Services to the District – Biosolids Drying System |
| | Level of Effort for Services to the District – Dried Product System |
| | Key Personnel Providing Design/Engineering Services |
| | Hourly Rates for Key Personnel Providing Design/Engineering Services |
| | Key Personnel Providing Non-Design Services |
| | Hourly Rates for Key Personnel Providing Non-Design Services |
| | Key Personnel Resumes |
| Tab F | Biosolids Drying System Questionnaire |
| | Dried Product System Questionnaire |
| Tab G | References |
| Tab H | Sizing and Operational Information (Calculations) |
| Tab I | Equipment, Spare Parts, and Tools |
| | Equipment List |
| | Spare Parts and Tools List |
| Tab J | Drawings |
| Tab K | Process and Instrumentation Drawings |
| Tab L | Control Strategies |
| Tab M | Technical Specifications (checked marked) |
| Tab N | Draft Contract (checked marked) |
| Tab O | Safety Assessment |
| Tab P | Comments and Additional Information |

To aid the selection of the proper dryer and manufacturer, the District and Design Team developed a detailed list of evaluation criteria. This list helped ensure an equitable and thorough selection process. The list included a wide range of criteria, each weighted according to their importance to the District in their dryer selection (see Table 4 below). The footnotes following the table (numbered 1 through 9) outline the factors that went into each criterion. These criteria can be applied to the selection of many types of equipment; however, they will be weighted differently according to the equipment and needs of the municipality or agency.

**Table 4 – Evaluation Criteria**

| *Evaluation Criteria* | *Maximum Points* |
|---|---|
| Product Quality (1) | 12 |
| O&M Considerations (2) | 60 |
| Manufacturer's Experience (3) | 30 |
| Operating Parameters (4) | 21 |
| Corporate Responsibility (5) | 24 |
| Risk (6) | 27 |
| Reliability (7) | 27 |
| Project Implementation (8) | 9 |
| Life-Cycle Cost (9) | 90 |
| Total | 300 |

(1) Regulatory issues, ease of product handling, end use issues, and dust.
(2) Flexibility of daily operation, startup/shutdown time, heating medium, product handling, and equipment complexity
(3) Key staff experience on the equipment proposed, general staff experience and design capabilities, experience with raw/partially digested sludge, experience history, experience with equipment proposed, and post installation modifications
(4) Exhaust treatment and process water impacts
(5) Financial stability, system support, warranty, and US corporate presence
(6) Health and safety, operating temperature, heating medium type, and safety record
(7) Materials of construction, operating time prior to major overhaul, time to perform major overhaul, and redundancy recommendations
(8) Siting (footprint), full System Supplier, schedule, and site construction impacts
(9) Labor requirements, fuel demand, electric power demand, oiling system, special equipment, end uses, process water demand and power cost, side stream treatment requirements, material and equipment (maintenance, overhaul), and capital cost.

Based on the RFP, the three manufacturers submitted detailed written proposals. The following section discusses the evaluation of the proposals and the selection of the dryer.

***4. Evaluation of Proposals and Selection of Dryer.*** After an initial review of each written proposal, the District proceeded with interviews of the three manufacturers in order to clarify any items and facilitate equal comparison of the three companies. These interviews consisted of specific, focused questions for each manufacturer, intended to fill in gaps and provide clarification of the proposals.

Meanwhile, the Dryer Team completed a detailed 20-year life-cycle cost analysis for each of the three manufacturers. The life-cycle cost analysis included capital cost of the biosolids drying system as well as a biofilter. The biofilter was included for odor control and differed between the manufacturers, due to the differences in their exhaust. Additionally, the life-cycle analysis included operating costs for power, water, natural gas, operator attendance, and biofilter media replacement.

The Dristrict then moved to a quantitative system of analysis, using the evaluation criteria discussed above to assess each aspect of the manufacturers' proposals. At an evaluation workshop between the District and Design Team, each District member (from the selection committee) rated each manufacturer individually on each selection criteria. Based on the District's scoring of the selection criteria for each proposal, the District ultimately selected Kruger's belt drying system (indirect-convective type). This belt dryer is one of only five currently under contract for a municipality in North America.

## DRIED PRODUCT SYSTEM

An optional aspect of the RFP for each manufacturer was to also provide the Dried Product System as part of the Scope of Equipment and Services (item two of the RFP). A Dried Product System conveys and stores the dried biosolids after the drying process. The bid and information for this System was not a determining part of the selection process, but if it was included in the proposal, the District retained the option to include the System as part of the manufacturer's Scope of Equipment and Services.

In this case, Kruger elected to not include the Dried Product System as part of their bid; therefore, the Design Team completed the design of the System, utilizing a pneumatic conveyance system and storage silos. Pneumatic conveyance systems are excellent for longer conveyance distances, high vertical lift, and because they do not agitate and break up the dried product, they create less dust. Dust can be explosive and appropriate safety measures are required, including grounding, dust collection, inerting, explosion panels or vents, or rupture disks (explosion panels can be of the flameless or chemical isolation type to contain the explosion; for example, when installed indoors). In general, any conveyance mechanism used for grains or finer coal particles should be sufficient for conveyance of dried biosolids; drag conveyors, bucket elevators, etc. The Dried Product System is now in the scope of supply of the General Contractor.

## FINAL DESIGN

During final design leading to preparation of bid documents for the Picnic Point WWTF Upgrade Project, the District and Design Team worked closely with Kruger (the manufacturer) as outlined in the RFP. Kruger provided the submittals as required and made modifications pursuant to the Design Team's requests. In addition to the Biosolids Drying System, the final design of the Solids Handling Building included the centrifuge for dewatering, waste activated sludge holding tanks, dried product system, and odor control. The entire design of the Solids Handling Building was completed in AutoCAD 3-D. Figure 7 and 8 show the exterior of the building and the biosolids drying system layout.

**Figure 7 – Architect's Drawing of the Solids Handling Building**

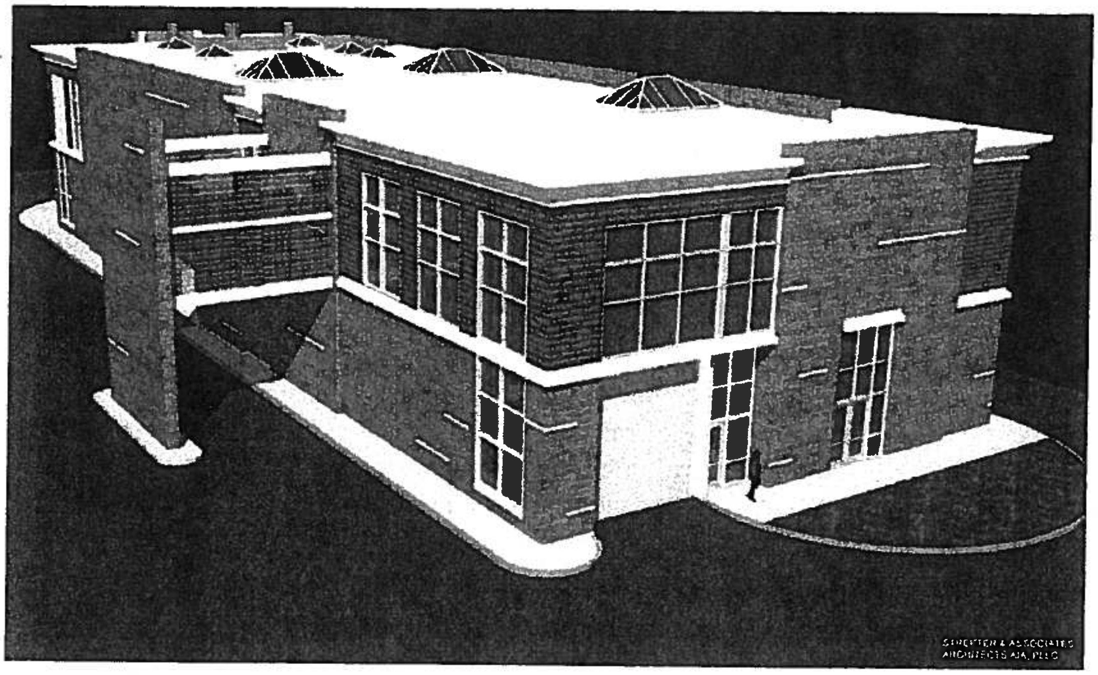
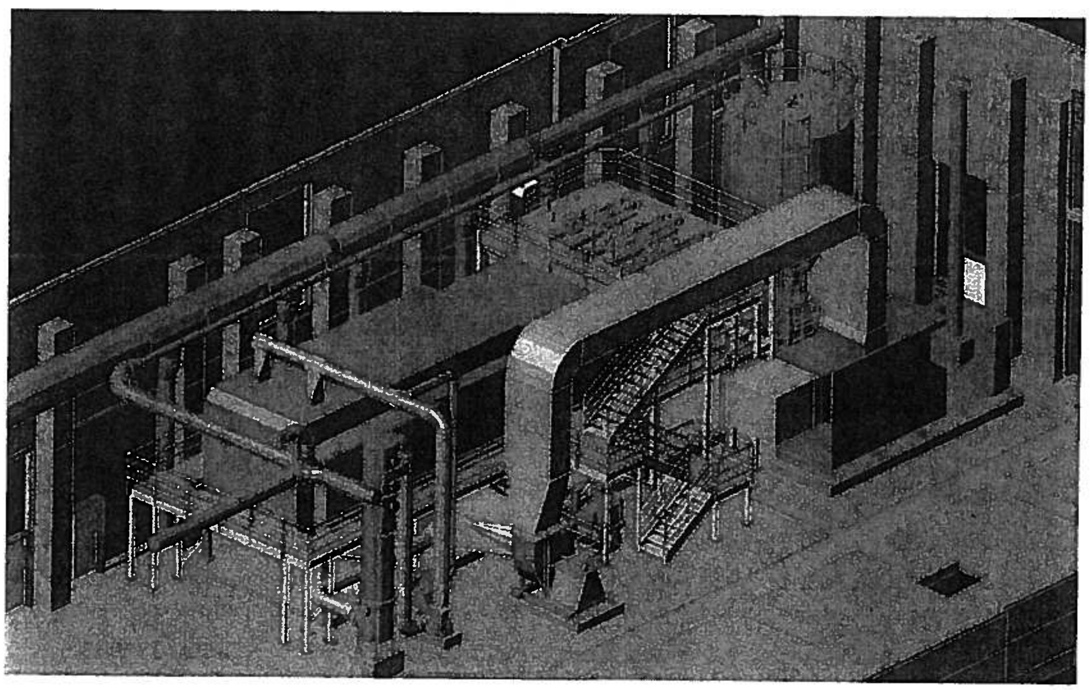


**Figure 8 – Three-Dimensional Drawing of the Biosolids Drying System (Kruger)**



## INCENTIVES AND ECONOMICS

Today, some governmental organizations offer incentives for municipalities to install dryers. For example, in the Pacific Northwest the state of Washington offers tax exemption on manufacturing facilities. If a municipality is drying biosolids for the purpose of manufacturing a fertilizer, all of the equipment and construction costs associated with the manufacturing process will be tax except. However, this does not include buildings, odor control, and HVAC and electrical systems.

In addition, utility companies may offer energy incentives. During this particular design process, the Design Team worked with the local utility company, Puget Sound Energy (PSE), under their Conservation Grant Program to receive funds for upgrading the thermal system with a high efficiency heat exchanger. The high efficiency heat exchanger has an efficiency of 92.7% as compared to only 82% for the conventional heat exchanger. PSE has agreed to provide approximately 70% of the additional cost of upgrading from the conventional to the high efficiency heat exchanger, resulting in a very short payback period.

## CONCLUSIONS

There are a variety of biosolids drying systems available to produce a Class A biosolids at municipal wastewater treatment plants. These systems are unique and the best choice will depend on a number of criteria, including capital and operating costs. Wastewater agencies may wish to consider implementation of a competitive procurement process prior to completion of final design to facilitate evaluation and selection of a system that bests meets its needs.

## ACKNOWLEDGMENTS

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