Good afternoon and thank you for attending this session on

How to Upgrade an Existing Biowaste Decontamination Installation.

My name is Carlyle Conn from ABC Actini in Lewis Run Pennsylvania.

The goal of this session is to identify the appropriate questions that need to be asked and answered when considering an upgrade to an existing decontamination system, and to provide some insight on assessing the needs, most efficient methods of upgrade, and the current technologies available.

The reason for an upgrade may come in many forms. This may be to increase capacity, it may be to add or change the type of pathogens, and it may be a change in process or BSL rating that results in a modification of the treatment scheme and increase in the volume of effluent that requires treatment.

To find the most appropriate system to meet your requirements, we need to consider some questions.

First and foremost, we need to determine the appropriate treatment for the upgrade or the change in the effluent stream. Reference can be made here to all the major organizations that provide guidelines for discharge to any public waste system. Also it is important to work with the local municipality and sanitary authority to assure their knowledge/approval of the change and documentation requirements.

Secondly, we need to clearly define the user's needs. What will be the new volume to treat? How will this interface with the existing infrastructure? What utilities will be needed for the new treatment? What changes will occur in the work pattern that will affect the effluent discharge, not only volume, but also its timing? What are the changes in the risk factor relative to a discharge of untreated effluent? All this should be carefully considered before a plan is developed.

Third, we need to evaluate the new treatment method and identify the most appropriate technology that will be most cost effective to change and provide the most efficient treatment long term. What alternatives are available and does this upgrade suggest the move to a new method or technology?

Let’s take a look at each of these three areas in a little more detail.

Treatment Efficiency - The most important questions is what is the new lethality that must be applied to the new waste stream? What are the possible treatment parameters?

Are we dealing with conventional or non-conventional germs?

Will the effluent need to be sterilized or inactivated?

If the agent is a GMO, what will be the treatment scheme?

The treatments for conventional germs are fairly well defined. Bacteria, viruses, parasites, fungus, contain DNA and the data on their thermal resistance is known. For example, the treatment scheme for viruses is typically 90 degC for 15 minutes or 105 degC for 30 seconds, and that includes a large margin.

When the data on the thermal resistance is not known, we apply the sterilization rate. This is a minimum F0 of 20, with 30 recommended and 50 generally applied.

The treatment for unconventional germs is a much more difficult to determine. These are infectious agents which are not bacteria/viruses, etc; does not contain DNA and the thermal resistance is not known. Prions' would be an example of this. The appropriate treatment for Prions is 134 degC for 18 minutes under pressure at 45 psi.

What about GMO's ? A **genetically modified organism (GMO)** or **genetically engineered organism (GEO)** is an organism whose genetic material has been altered using genetic engineering techniques. These techniques, generally known as recombinant DNA technology, use DNA molecules from different sources, which are combined into one molecule to create a new set of genes. This DNA is then transferred into an organism, giving it modified or novel genes. Transgenic organisms, a subset of GMOs, are organisms which have inserted DNA that originated in a different species. However, as GMOs contain DNA, we can treat them as conventional germs.

If the data on the thermal resistance is known, the treatment is generally 110 degC for 1 minute.

If the data is not known, we apply the sterilization rate with a minimum F0 of 20, with 30 recommended and 50 generally applied.

Let's talk a minute about the lethality rate. The lethality rate is based on a reference germ, Baccillus Stearothermophilus .

F0 = 1 would be 121 degC applied for 1 minute.

Therefore F0 = 30 would be 121 degC applied for 30 minutes.

There is a direct correlation between the amount of time and the temperature to obtain a specific F0

For example, F0 = 30 of 121 degC for 30 minutes is exactly the same as 130 degC for 3.9 minutes

And 135 degC for 72 seconds

And 140 degC for 24 seconds

And 145 degC for 8 seconds.

This principal gives rise to the possibility of continuous flow decontamination systems where the holding time can be reduced by increasing the temperature, thus allowing the fluid to continue to flow without having an extremely long pipe, and a complete system with a much smaller foot print than a batch decontamination system. These are typically chosen when the treatment volume is large.

Once the treatment efficiency is determined, we need to think about the volume and flow parameters.   Is the effluent flow steady throughout the day, or is there a large batch flush, then no effluent for a period of time? Graphing the hourly flow rate over time provides an analysis that helps determine the type of system and requirements for tank storage.

We need to determine if the current cycle being analyzed will change in the future? Will the employee's showers be added or increased? Are there other equipment adders to the process that will change the effluent stream in the future? Are there extraordinary situations that could cause a significant change in the effluent stream? Will there be a change in any particulate size or frequency?

This next slide shows an example of a storage sizing analysis. The estimation includes all the fluids that will be coming from different sources during different cycles.

Consider the Fermentor CIP, Fermentor SIP, Fermentor Rinse, vessels, steam condensate, etc,

Consider the peripherals like the sinks, floor waste, safety showers, eye wash, etc.

Consider the ancillary fluids such as cleaning solutions, acid, soda, etc.

From this work sheet, we can determine the total flow collected per day. In this example, it is 57,745 LPD. We would be happy to provide a copy of this worksheet to anyone that is interested.

The next slide shows an example of the flow sizing analysis. The chart illustrates the hourly volume of live waste introduced into the storage tank, an accumulated total of live waste, the hourly flow through the decontamination system and its status, the total decontaminated volume, and the storage balance.

As you can see, the system operates at a low flow rate through most of day 1 until hour 18, when nearly 3000 L of live waste is introduced. The system goes to high flow until the volume of the storage tank is reduced from the high of 4825 L to 850L, then the system automatically returns to a low flow rate progressing through day 4.

This analysis shows the maximum hourly volume collected at 2,945L, with the total volume in this cycle at 28,311.

From this data, we determine the capacity needed for the storage tank, and the correct decontamination system capacity for the most safe and efficient operation.

The recommended storage tank capacity is sufficient for 1 day operation, however depending on the total volume, a larger tank of 3 days to 1 week may be suggested.

The decontamination system capacity minimum is a 20 hour continuous operation, however it is recommended that it be sized for 16 or even 8 hour operation.

Now the question is asked, do we consider a very large storage tank with a relatively small treatment unit, or a small storage tank with a larger treatment unit?

For plants having large flow rates during short periods several times per week, a large storage tank is selected, with a smaller treatment unit.

For plants having a large regular flowrate with no peak flows, a smaller storage tank is selected with a larger treatment unit.

Now that we have determined the appropriate treatment parameters, and have clearly defined the user's needs and capacity requirements, we need to explore the available technologies to determine the most efficient system that provides the appropriate treatment efficiencies while meeting the needs of the users.

The first obvious question is will it fit within the existing space dedicated to the waste system. What modifications need to be made to the existing room? Will this be housed in a new building or expansion of existing building?

The answers to these questions will play a large role in determining the type of system that will be selected. The most typical questions are whether we consider batch technology or continuous technology.

If we have ample space or if this is new construction, it is quite possible that a batch system will be the most appropriate technology.

If the available space is small and there are not funds available for building modifications or expansion, then a continuous system may be the best solution.

Once determined, the first question to be asked is if we can use some of the existing equipment. If a batch system has been selected, what will be the modifications necessary to upgrade? Will additional kill or balance tanks be necessary?

If a continuous system is selected, and the existing kill system is batch, quite often we see the kill tanks be used as the balance or storage tanks for the continuous system. Since continuous systems have a relatively small footprint, often it can be installed next to the existing tanks. They can remain in place and can be tied into the continuous system with minor plumbing work.

The next most important question is the availability of the utilities necessary for this upgrade. Batch systems require a significant volume of steam. Is steam available, and is it sufficient for this application? If steam is not available, some continuous systems work on electricity. What are the available electrical services available? Batch system requires a good amount of cooling water or in some instances chilled water to cool. Is this utility available in sufficient quantity for this application? What is the cost of providing this volume of water or chilled water?

Next we can look at an example of a need to increase capacity, in this case double, with the goal of no change in the utility requirements or facility layout.

Before the upgrade, this facility was operating two (2) 2,000L batch kill tanks sufficient to handle 20,000 liters per day of effluent.

The expansion plans call for a total of 40,000 liters per day of effluent to be treated, twice what the existing system will handle.

To expand this utilizing batch technology would require larger vessels and quite possibly a building expansion.

In this example, the client selected a 2500 LPH continuous system and utilized the existing kill tanks as balance tanks. No additional tankage was required nor any building expansion.

From an operating cost perspective, the existing batch system handling 20,000 L of effluent per day used 470 lbs/hr of plant steam, 27,000 L of cooling water and 5 kwH of electricity. The daily utility cost was calculated at $81.35 per day.

After the upgrade, the continuous sytem handling 40,000 L of effluent per day used 275 lbs/h of plant steam, 3,000 L of cooling water 23 L of cleaning solutions and 40 kwH of electricity. The daily utility cost was $70.58 per day handing twice the amount of effluent.

In this example the continuous system selected had a foot print of 6’ by 13’. The existing batch tanks were not moved and there was sufficient space to install the continuous system with no building modifications.

This slide illustrates the main differences in the utility requirements of batch vs. continuous technology.

In a batch system, we have a large volume of effluent to be heated at one time requiring approximately 3 ½ times the amount of steam to bring to and keep at temperature for the kill cycle. Then this effluent needs to be cooled before it can go to drain, requiring as much as 9 times the amount of cooling water to cool the large volume within a reasonable operating time.

A continuous system is very energy efficient utilizing a pre-heating energy recovery system with no need for chilled water in most applications.

In the previous example, the daily operating costs if a batch system would have been selected would have been $160.70 per day compared to $70.58 for the continuous system.

This equates to approximately $33,000 in operating cost savings each year.

In this example, the decision to select a continuous system reduced construction costs, resulted in very little downtime for the installation and validation, reduced the energy consumption requirements and was sized sufficiently for further capacity increases.

I can give you a little more details about the continuous technology.

This slide illustrates a BSL-2 Electrical continuous flow decontamination system.

The contaminated effluents enter the storage tank with two level sensors to start and stop the continuous system. As the storage tank begins to fill and reaches the limit, the PLC starts the decontamination system. Water from the starting tank is pumped by the redundant centrifugal pumps, through the energy recovery system, increasing the temperature from approximately 20 degC to 115 degC., is then heated as it flows though the electrical heat exchanger and heated to the 135 degC kill temperature, then through the holding section. Once the system is stable at the operating parameters, the effluent stream is started.

The next slide illustrates the treatment process. In this case there are some solid particulates in the effluent so the addition of an inline crushing system, with strainers installed before the pumps,   The system is designed per the appropriate security integrity levels and has multiple temperature sensors to shut down the system in the event the treatment temperature after the holding section has fallen at all below the treatment temperature.

The effluent enters at 20 degC and exits at 40 degC, therefore the energy consumption is the flow rate x a 20 degC increase in temperature.

One of the keys to the continued successful operation of a continuous system is the single pass design. The system contains an automatic CIP functionality that is executed at the appropriate time at the operating temperature. This assures that any fouling/ scaling is removed and the efficiency of the system is in tack.

This is an illustration of a single pass electrical system. There is a low power transformer and thyristor controlling the current to the system. The low voltage is applied directly to the pipe which acts as a resistance to the current. If plant steam is not available, electrically operated systems are very appropriate for continuous systems up to a certain flow rate.

There are costs and benefits to both steam and electrical systems but the choice is there as the application dictates.

Finally, I wanted to show you the Energy Recovery System. The biowaste stream is pre heated from 20 degC to 115 degC as it passes through the heated treated waste. The treated waste is then cooled from 135 degC to 40 degC, with no additional energy used for either the pre heating or cooling. This is one of the main (GREEN) reasons for choosing a continuous system.

Thank you for your attention and for allowing me to share this with you. Please feel free to call me if you have any questions.

Carlyle Conn, ABC Actini Sales Manager

888-278-8544 : Phone

814-362-4674: Fax

salesabc-actini@abc-actini.com : E-mail

www.abc-actini.com : Website