Smart Water Fund

Milestone 3

Reuse of condensate 52R-2031

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With the support of the Smart Water Fund

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City West Water
Melbourne Water
South East Water
Yarra Valley Water
Department of Sustainability and Environment

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Executive Summary

Founded in 2001, Longwarry Food Park is continuously striving towards becoming environmentally friendly by introducing and trialling sustainable initiatives to reduce greenhouse emissions and looking at innovative ways to reduce potable water use.

A milk powder production plant uses 1.5 litre of water for every litre of milk processed (State of the environment report by Dairy Australia). The milk powder production process removes about 0.75 litres of water from every litre of milk. This water cannot be used currently due to presence of Biochemical Oxygen Demand (BOD) and milk volatiles. The available technology of Reverse Osmosis is highly energy and maintenance intensive and is not a viable solution. Longwarry Food Park aim to use an innovative ozone based treatment from a company called Ozone Industries to treat the water content removed from milk in the production of powdered milk to remove BOD''s & milk volatiles to enable the water content to be re-used. Our water usage for the year 2005-06 was 1.27 L/L of milk. We had the potential of reducing it to 0.5 L/L of milk.

As this was a Research & Development project, we had carried out pilot scale trials with help from Hydroflow. The trials proved to be positive and the complete installation and commissioning of a full scale trial was undertaken.

On completing the installation, we encountered various Occupational Health & Safety (OHS) issues and some process issues with the operation of the unit. These have been listed in detail in this report. To mitigate these issues, we had made a request for some more funds in from South East Water (SEW) as a separate application which did not meet the competitive criteria of the grant and was refused.

We continue to believe that through careful risk assessment and planning the technology can be successful and may seek funding from alternative source at a future date to continue the research.

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Background

In 2001, the Saurin Group purchased Longwarry Food Park and sought to re-establish the plant's heritage and link to the local community. Having been shut prior for 7 years, the factory underwent substantial upgrades and investment to achieve a world class status and commenced milk processing on the 1st of July 2005.

The plant has since been upgraded to make establish a state-of-the-art and eco-friendly powder manufacturing facility. These upgrades include:

- Reduced water, electricity and gas consumption through technological innovations
- Almost 100% recycling of packaging materials
- Installation of an automatic bagging line, reducing paper usage by 40%
- Optimisation of the plant to increase capacity
- Upgrade of existing boilers to use high-efficiency boilers

As part of pursuing environmentally friendly business practices, Longwarry Food Park identified an opportunity to further improve water efficiency by using an innovative ozone based treatment from a company called Ozone Industries to treat the water content removed from milk in the production of powdered milk to remove BOD''s & milk volatiles to enable the water content to be re-used.

The water removed from the milk (known as condensate water) was injected with ozone gas to remove any proteins, fats, sugars, etc which will produce Class A quality water. Our Milk Powder plant produces a large quantity of condensate per year.

The proposal was that this water will then be used primarily for the cleaning of the plant (trucks, equipment, etc) & in cooling towers. It is able to be used for most applications except for drinking & in the food production area. The process was to be monitored over a six month period to ensure that it is meeting the needs of Longwarry Food Park and to ensure it meets Class A standards and that all safety standards are met .

Introduction

Ozone was first used by municipalities to improve the organic qualities of water with control of taste, odour and colour as well as for its germicidal action. Application of ozone in waste water treatment includes the destruction or removal of: complex organic molecules, cyanides and phenols from chemical waste, etc. In addition, subjecting municipal waste waters or combined municipal waste waters or combined municipal industrial waste waters to a final ozone process enables reuse for applications such as wash-water, irrigation, or fire fighting systems.

Ozone is also used extensively in industry in oxidation processes and for disinfection purposes. Typical industrial examples are in the P&P industry for pulp bleaching, chemical industry where ozonolysis is necessary for the production of certain substances, and in cooling-tower systems where ozone replaces the less desirable chemical biocides.

Key deliverables for the project include:

- Reduction in water use (50 – 85ML per year) at the Longwarry site;
- Reduction of water bill (app $42,000 per year);
- Facilitate & encourage the adoption of improved water resource management practices by the milk powder industry through this demonstration project.

Objectives/Goals

The main goals for this project are:

- Demonstrates an innovative sustainable water management plan
- Focuses on water recycling and water conservation saving within the business
- Demonstrates innovative methods and benefits to conserving water and reusing it within the same process
- Facilitate and encourage adoption of improved water resource management practices within the Powdered Milk Industry

The estimated savings had the project succeeded;

Year	Milk Intake	Water Use if nothing done (KL)	Water Use if this implemented (KL)	Water Savings (KL)
07-08	70 Million Litres	88,900	35,000	53,900
08-09	90 Million Litres	114,300	45,000	69,300
09-10	110 Million Litres	139,700	5,000	84,700

Milestone Description

Milestone 1

Milestone Description

This milestone provided a detailed Project Plan for the project and also looks at the various Communication activities that will be undertaken throughout the life of the project.

Methodology

Scope of the project will be assessed by the project engineer in conjunction with Alistair Lockey from Water Werx Pty Ltd to assess the following points.

- Is ozone generation a suitable system for water treatment in a food environment?
- What equipment will be required to complete project.
- Assessment of what existing resources could be utilised.
- Where equipment can be positioned within the factory.
- Formulate plan detailing timeline testing and commissioning.
- Identify flow streams to determine what water will be suitable for treatment.

Resources

Jason Vergers	Saurin Engineering
Alistair Lockey	Water Werx Pty Ltd
Rakesh Aggarwal	Saurin Engineering

Timing

Due Date: 19 March 2008

Financial Summary

Funding Contributions for Milestone 1		
Source	**Amount**	
	$	**In kind**
Smart Water Fund	$5,000	
Dept of Primary Industries		
Other (Longwarry Food Park)		

Key Performance Indicators

- All existing equipment identified
- Process streams identified with volumes.
- Factory layout completed with new equipment identified.
- Assessment of completed project to obtain a satisfactory outcome.
- Report sent to SWF for approval

Milestone 2

Milestone Description

Order equipment identified in milestone 1 and on receipt install as per the specifications supplied by Alistair Lockey from Water Werx Pty Ltd.
As this system is fully automatic a computer programme will be written to control system, this will be developed in house by parent company Saurin Engineering.
Instillation of heat recovery system and associated pipe work including automated valves to deliver untreated water to the ozone generator at the desired temperature.

Instillation of treated water delivery system to predetermined points of use with inbuilt safety to avoid cross contamination with existing source of potable water.
After instillation a commissioning phase to determine the project viability and safety will be conducted by Jason Vergers and Alistair Lockey.

Methodology

- Install heat recovery system to supply additional heating to dryer inlet air while cooling the waste water stream to the desired temperature.
- Install pipe work and valves linking the waste water stream through the heat recovery to the storage tank.
- Install ozone generator and link to storage tank for treatment of water.
- Install ozone monitoring equipment to maintain residual ozone levels as required
- Install computer programme and integrate with existing system including alarms and operator interface.
- Commission individual components to ensure systems are operational.
- Assess overall safety of process covering food safety and operator safety.

Resources

Jason Vergers	Saurin Engineering
Alistair Lockey	Water Werx Pty Ltd
Rakesh Aggarwal	Saurin Engineering
Daniel Centofanti	Tech Automation
Des Grylls	Grylls Engineering

Timing
Due Date: 30 April 2008

Financial Summary

Funding Contributions for Milestone 2		
Source	**Amount**	
	$	**In kind**
Smart Water Fund	$68,000	
Dept of Primary Industries		
Other (Longwarry Food Park)	$135,000	

Key Performance Indicators

- Install all equipment by due date.
- Commission plant to operational status.
- Determine treated water quality for reuse.
- Assess plant operation for safety.

Milestone 3

Milestone Description
Monitor the Ozone system during production in accordance with approved Monitoring Plan.
This was conducted in two stages firstly samples were to be taken of the treated water but this water was discarded until satisfactory results were achieved. Secondly end use

trials were to be conducted on individual water use sources that were identified in milestone 1.
Water samples were taken by Alistair Lockey to initially determine the treated water quality and suitability at each end point of use

Methodology

- Untreated water was collected and treated with ozone.
- Samples were taken by Alistair Lockey from Water Werx Pty Ltd and tested for reuse suitability.
- Treated water was discarded and collection silo cleaned ready for next trial.
- Process was duplicated until sufficient positive data was received to enable live trials.
- Live trials were conducted by Jason Vergers and Alistair Lockey on non product streams to determine the overall suitability of the process.
- Overall safety of the system was assessed before handover to operators for use.

Resources

Jason Vergers	Saurin Engineering
Alistair Lockey	Water Werx Pty Ltd

Timing
Due Date: 30 October 2008

Financial Summary

Funding Contributions for Milestone 3		
Source	**Amount**	
	$	**In kind**
Smart Water Fund	$2,000	
Dept of Primary Industries		
Other (Longwarry Food Park)		

Key Performance Indicators

- Tested water is sterilised and found suitable for live trials.
- Live trials conducted on non product streams to determine suitability across all cleaning systems.
- System found safe to use by operators.
- Verify alarm monitoring of safety systems.

Results

The Ozone Treatment System was installed and monitored. We have seen that the water treated is showing residual ozone and is being measured by the ORP and Ozone probe. This is a good indication that there is a residual level of ozone left over after the oxidation of biological load. Testing showed the there was no problem with sterility of the treated water but an unexpected result of the ozone treating was a precipitate forming in the treated water. This limited the treated water use to non product stream use, seriously limiting the applications it could be used for.

One of the non product stream usages was the water for Spray Dryer wash (a spray dryer is unique equipment used for drying food products because it limits the heat damage to the product. Typically a spray dryer operates at 200 C but the food temperature does not exceed 80 C).
The treated water was used for the initial rinse and caustic wash. The results were initially promising with no noticeable difference in the wash with recovered water.
Due to variation in the quality of the untreated water it was found that there was a very high concentration of ozone required to ensure sterility. During further testing within the plant we found that the high level of ozone required for treatment of the water was flashing off when the water was put into the balance tanks for the CIP system. This excess ozone was building up in the building making our operators unwell. It was deemed too dangerous to continue with this technology in its present form and the system would require a considerable upgrade to achieve the desired result.
One benefit was the heat recovery system giving us a saving in gas usage within the dryer resulting in a 300,000 Kcal per hour saving in energy.
Overall the plant has failed to achieve its objectives.

Risk Management

The technology of using Ozone for treatment of cow water is innovative and has never been tried before. We had conducted a resource audit with support from Sustainability Victoria. This project is based on the evaluation of the resource audit and by Sustainability Victoria. For any project that is at the cutting edge of the technology, the risk of failure is always present. To mitigate the risk, we did trial the ozone technology on pilot scale in consultation with the company recommended by Sustainability Victoria.

Discussion/Evaluation

The issues that arose from the installation are:

- The water temperature is critical as ozone does not stay in water above 30 C. This has been designed in the system. The system has a dump mechanism if the temperature exceeds the limit.
- The residual ozone needs to be maintained at a maximum level. Excessive ozone can come out of the water and can be corrosive. Two independent circuits have been used for control to provide a natural backup.
- The waterflow through the ozone introduction probe needs to be a minimum level. To ensure that the flowrate is constant for the probe but higher for the usage, we have installed a variable speed control and a by-pass line with an isolating valve.
- The ozone generator is very sensitive to impurities. The system has been provided with air filter and was purged for 48 hours before turning it on.
- There was a delay in original testing on bench top that delayed the project. We wanted to be sure about the plant sizing as there was no precedent information available. We took samples of our water on different days and treated with ozone. The water was then tested for BOD and results were found to be satisfactory and in line with our expectation of water to be used for plant cleaning. By taking samples on different days, we were able to cover the normal process variations.
- The damage to oxygen unit in customs delayed our project further as it happened during Christmas break.
- Training of operator on a completely new technology.

The issues that arose from the commissioning were:

1. O H & S issue. Ozone flashing off caused headache to staff. Reluctance to use.
2. The condensate water quality varies with season (grass and feed for cow dependent) made it hard to predict required ozone generation. This is mainly due to the amount of volatiles in the milk that end up in the condensate.
3. The BOD levels for condensate varies & can be very high and ozone cannot treat it to the desired level.
4. The water flow rate constantly varies due to this being extracted from a vacuum system.
5. The storage tank is not big enough to compensate for the variance and provide greater residence time.

- For each issue, mitigating strategies that can be implemented in an attempt to resolve

1. O H & S issue. Ozone leak caused headache to staff. Reluctance to use. An ozone sensor in the atmosphere has been installed. It is connected to an alarm and auto shutdown of the plant. The system still has a risk of failure that can cause serious damage to staff.
2. The condensate water quality varies with season (grass and feed for cow dependent): The variation cannot be controlled. However a larger tank with greater residence time can even out the variations to a large degree.
3. The BOD levels for condensate vary & can be very high and ozone cannot treat it to the desired level. Nothing done but a larger tank and greater residence time can mitigate the problem.
4. The water flow rate constantly varies due to this being extracted from a vacuum system. Variable speed drive tried with limited success.
5. The storage tank is not big enough to compensate for the variance and provide greater residence time. Nothing done due to shortage of funds.

- The following investment could resolve each issue?

1. O H & S issue. Ozone leak caused headache to staff. Reluctance to use.: If we install the unit in open air, the problem would disappear. It needs relocation of the unit, rewiring and reprogramming. **Cost estimate 25,000 A$.**
2. The condensate water quality varies with season (grass and feed for cow dependent). A larger tank (about 200,000 litres) can address the issues 2,3 and 5. **Cost estimate 110,000 A$.**
3. The BOD levels for condensate varies & can be very high and ozone cannot treat it to the desired level. : See 2 above
4. The water flowrate constantly varies due to this being extracted from a vacuum system. A level sensor controlled variable speed drive can address the issue. **Cost estimate 7,500 A$.**
5. The storage tank is not big enough to compensate for the variance and provide greater residence time. : See 2 above

The Benefits and Learning:

1. The BOD due to volatiles in the milk condensate can be effectively neutralised using ozone.

2. The O H & S issues of using Ozone are serious and must be addressed in the design. These must make the system fool-proof. The risk is so great because the gas has no smell and its presence can not be sensed by human body (unlike ammonia) and the damage possibily to humans is very high.
3. It is not a system that can be used in-line with little storage. No or little storage may work when using clean water as the starting material but not with contaminated water.
4. In-line filteration is required for removing the floating material generated by ozone reaction.

Return on Investment

As the project did not succeed, there has been no real measurement of return on investment.

Conclusion

Though the project was not successful we believe that the project does have potential and Longwarry Food Park may pursue other avenues of funding to take this project further. We believe that the plant will provide us the desired outcome and allow us to reuse the water. It will require close monitoring to ensure that we do not endanger the food products by reusing this water.

Recommendations

We continue to believe in the project. The basic requirements of sterility have been met. The other issues that arose can be resolved with more funding and perseverance. Our **suggestions** are as follows:

1. Install the unit in open area.
2. Install a large balancing tank.

- We suggest that Smart Water should make **amendments to policy** to be flexible with further funding when the cutting edge technology projects are so close to a desirable outcome. This funding can be 1 A$ for every 2 $ contributed by the company.

Acknowledgements

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Document Status

Version No.	Author	Date
1.0	Rakesh Aggarwal	
2.0	Rakesh Aggarwal	4th Jan 2011