Carbon reduction through the introduction of new cleaning and disinfection methods within food hygiene

Summary

Ozo Innovations (Ozo) has developed a sustainable cleaning method to reduce the consumption of scarce resources in food production. Electrolysis of saline solutions produces a highly effective cleaning and disinfectant solution. This project provided the opportunity to demonstrate the application of the technology on a large scale in a food manufacturing environment and to evaluate the savings that can be made by moving to the eloclear™ two-step process versus the Industrial Partner's traditional method. The objective was to utilise eloclear™ within 50% of the factory as a direct comparison with the existing cleaning method.

The Industrial Energy Efficiency Accelerator (IEEA)

The IEEA programme supports the development of innovative technologies that will help industry reduce energy consumption and cut carbon emissions. It focuses on innovations with large potential cross-sector energy and carbon reduction impact - either new technologies or established technologies applied to new sectors. Over £15 million in public and private funding has been committed to develop solutions through partnerships between technology developers and industrial companies willing to test technologies on-site. The programme is funded by the UK government (BEIS) and managed by the Carbon Trust, with support from Jacobs.

Introduction

The core technology is well established, and electrolysis of saline solutions (including seawater) has been known for many years. Ozo recognised the opportunity to adapt and optimise this technology and make a significant contribution to reducing the carbon emissions within one of the top 10 global industries – food.

Subject to meeting specific customer efficacy standards, eloclear™ will significantly reduce the carbon footprint of the hygiene operations within a food production environment. By replacing traditional cleaning methods using chemicals and hot water, with eloclear™ applied between 20-25°C, energy consumption is reduced. The energy is further reduced by reducing the re-chilling costs caused by using hot water. Depending on the soils, there is an opportunity to reduce cleaning time and the volume of water required. With reduced cleaning time, this provides an opportunity to increase production, increase factory Overall Equipment Effectiveness (OEE) and, in turn, improve margins.

The margins within the food industry are low and the project was capital intensive despite the potential to provide a substantial return on investment. For this reason, it was vital to have the financial support of the IEEA to demonstrate this technology.

About the innovation

Ozo Innovations (Ozo) has developed a sustainable cleaning method to reduce the consumption of scarce resources in food production. Electrolysis of saline solutions produces a highly effective cleaning and disinfectant solution.

Figure 1 – eloclear application process

eloclear™ is a form of electrolysed water (EW) manufactured by the electrolysis of a salt brine made from food-grade salt. It is generated with a free available chlorine (FAC) concentration of 1800-2100 ppm at a mildly alkaline pH (8.8 - 9.1). Free available chlorine refers to the main chlorine constituents of the eloclear™ formulation; namely hypochlorous acid (a powerful disinfectant) and sodium hypochlorite (an effective cleaner). eloclear™ is designed to be manufactured and delivered to point of application at <25°C.

The demonstration

This project provided the opportunity to demonstrate the application of the technology on a large scale and to evaluate the savings that can be made by moving to the eloclear™ two-step process versus the Industrial Partner's traditional method. The objective was to utilise eloclear™ within 50% of the factory as a direct comparison with the existing cleaning method. However, Ozo was not involved with the collection or collation of the baseline data from the current cleaning method used for comparison purposes. The project included the design, build and installation of an elosystem™ at an Industrial Partner's site in conjunction with the installation of a dedicated distribution system to distribute eloclear™ to the relevant application points. A number of sensing devices were installed to monitor the relevant utilities. Key members of staff were trained on the benefits and use of eloclear™. The decision was taken to follow a train the trainer approach; therefore, 20 staff were trained who would take responsibility for training up to a further 110 members of staff.

In order to use eloclear™ within the Industrial Partner's site, a series of efficacy trials were undertaken, requiring a 100% pass rate of the equipment for both micro and allergen testing. The trials consisted of 3 sets of 3 nights over a 3-month period. The environment being cleaned was high care, with the primary focus (from an allergen perspective) on Casein. The three trials undertaken achieved microbiological results between 95% and 99% and allergen results between 94.5% and 98.6%. The target set by the Industrial Partner required a pass rate of 100%, consequently the full demonstration was not undertaken.

These challenges resulted in delays to the project which then coincided with the COVID-19 lockdown, limiting the time available to carry out further application development.

Monitoring

The focus of intervention was to be limited to the assembly area of the Industrial Partner's factory. Within this area, energy efficiencies were to be measured in different zones. There were four interventions, each of them measuring energy and water consumption for cleaning different types of equipment used for food production.

A. Production lines

B. Wash area

C. Automated wash area

D. Cooking area

A variety of sensors were deployed across the site to measure the consumption of utilities including gas, electricity, water and waste.

Results

The energy savings are an extrapolation of the original trial as no demonstrations on large areas were carried out during this project as indicated above. If the efficacy challenges can be overcome energy savings could be realised as per below.

Gas consumption would be reduced with the move from hot to cold water as shown below.

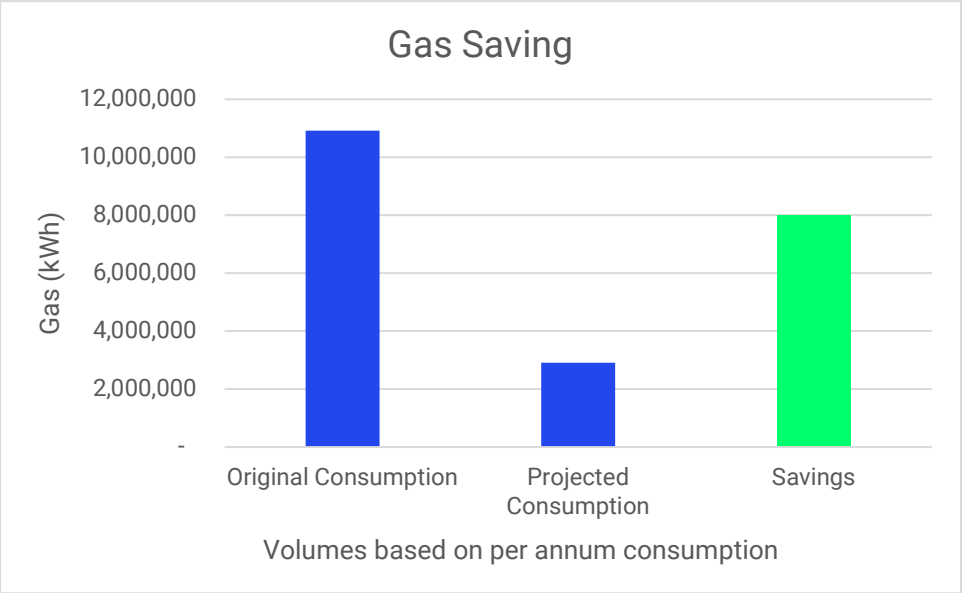

Figure 2 - Potential Gas Savings

Electricity costs would reduce as rechilling load declines due to the use of eloclear at an ambient temperature. The electricity savings are net of the electricity used in the production of eloclear™ as shown below.

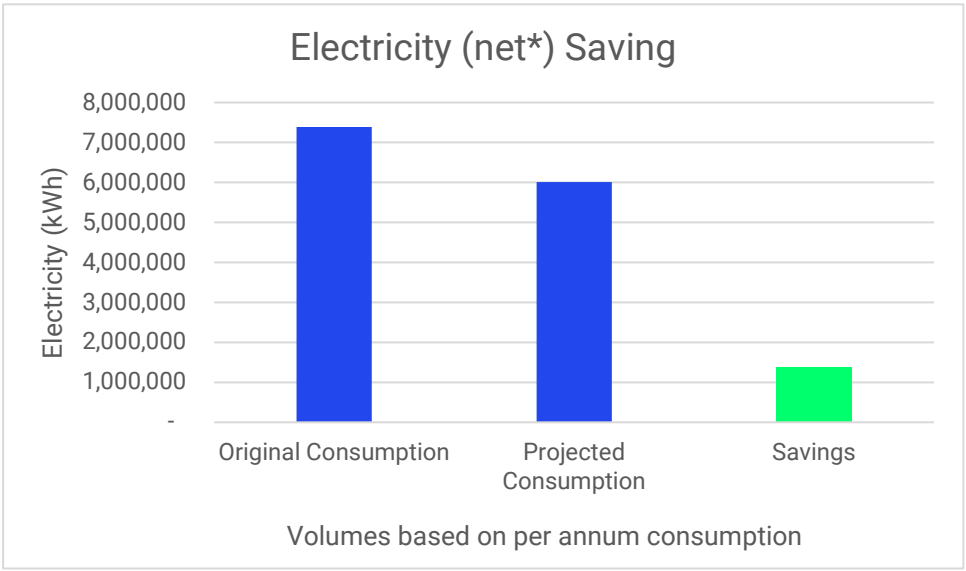

Figure 3 - Potential Electricity Savings

The combined Carbon savings from gas and electricity are shown below.

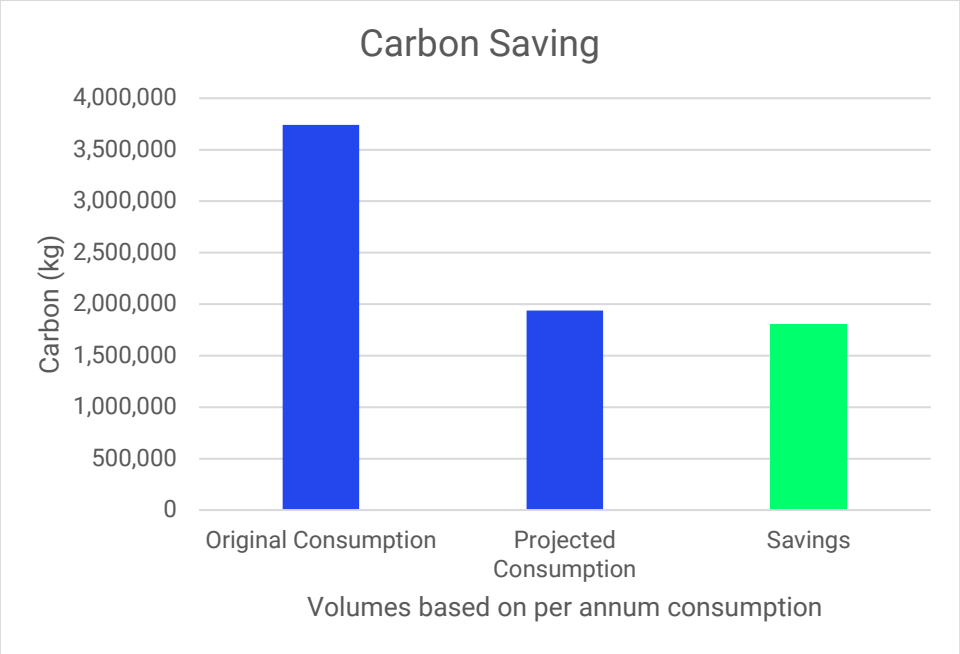

Figure 4 - Potential Carbon Savings

Further savings would be generated due to the reduction in the purchase, transportation, storage and handling of chemicals. The savings were estimated to be 43% of all hygiene chemicals used on site.

Due to the limitations of not completing the full demonstration, the labour, water and OEE benefits could not be calculated.

Future impact

The Ozo solution has potential across the entire food industry and potentially in non-food industries requiring a wet clean process. Ozo is now working with a number of global and national food groups providing access to multiple target markets including protein (meat, fish & plant), food to go, ready meals, ingredients and bread. Ozo is also investigating the potential of Cleaning in Place (CIP) as distinct from equipment that requires dismantling or removing to be cleaned. Ozo is forecasting to install the elosystem™ in two or more factory sites over the next 12 months with the intention of deploying 200+ elosystems over the next 10 years. Dependent on volume, this would generate total carbon savings of 300,000 tonnes. There would also be a reduction in the use of harsh chemicals with a further environmental benefit by reducing production, transportation of both the chemicals and the packaging.

Innovation lessons

The scope of the project would have benefited from being more focussed on a more selective range of equipment and area of the factory, allowing more time to focus on collection/analysis of data and method development as results were achieved.

The temperature of eloclear™ normalised to the ambient temperature of the environment over periods of inactivity. The temperature could be impacted by external temperatures and the temperature in the factory. In the future, ensuring the distribution system is sufficiently lagged and/or incorporates trace heating would be beneficial.

The elosystem™ v1.1 was designed as a batch system incorporating 3 reactors which each had 10 small electrolysis cells requiring individual power supplies. A continuous flow system would be more beneficial than a batch system and is simpler to control and operate effectively at scale. This design has been incorporated into the next version of the elosystem™. A new single pass, continuous flow design which is 70% more efficient than the elosystem™ that was built for this project. This approach has also significantly reduced the capital and support costs of the system by 52%.

The training of Operators carrying out the cleaning process involved a 'train the trainer' approach training 20 Operators. Working with a dedicated team of Operators to optimize the use of eloclear™ for the benefit of efficacy and water/time reduction would have been more productive to deliver the project prior to a wider rollout.

During the trials, methods for cleaning were developed then tested. Further method development was not achievable within the timescales of the project. There are a few key lessons learned as follows:

- When adverse results were achieved the strategy was to evaluate all pieces of equipment in a broad perspective rather than investigate a few pieces of equipment in the full level of detail. If this approach had been followed, it may have left an opportunity for method development within the timescales of the project.
- The installation of the eloclear™ process is a significant change to an operation and cannot be viewed as a simple hygiene chemical change.
- Complete side by side trials of the existing and new cleaning process for comparison purposes does not need to be carried out for every item of equipment, but in enough cases to identify trends.

A detailed comparison with benchmark data from the current cleaning process would have been beneficial. This would have provided a better understanding of where the challenges lay, and the focus needed to be able to optimize the cleaning of an item of equipment.

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Industrial Energy Efficiency Accelerator delivered and supported by:

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