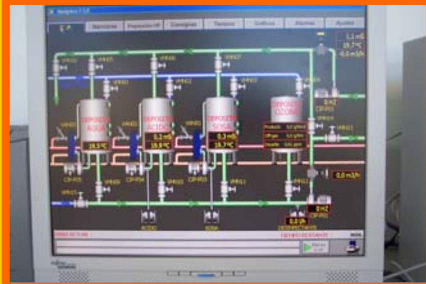
www.ozonecip.net



Ozone Clean in Place In Food Industries
LIFE05 ENV/E/000251

Demonstration project of the environmental advantages of integrating ozone technologies in clean in place systems in food industries

Background

All Food Drink and Milk (FDM) industries, regardless of their size, geographical location or point in the production process, must comply with the required food safety standards. Cleaning is the total removal of organic material wastes or product components and other visible pollution. Whereas disinfection pretends to remove all pathogenic micro-organisms and the most of non pathogenic that would affect the product quality. A cleaning program can be composed of some of the following steps:

Pre-rinsing
Cleaning Cycle: The cleaning cycle may include: Caustic wash, Intermediate rinse, Acid wash, Rinse
Disinfection
Final Rinsing.

Nevertheless such operations produce a significant environmental impact(*) in terms of water consumption and wastewaters.

Fresh water → Cleaning and Disinfection of Equipment → **Wastewaters:** Polluted with product remnants and C&D chemicals

Chemicals: → Cleaning and Disinfection of Equipment

(*)EUROPEAN COMMISSION- Directorate-General JRC Joint Research Centre – Institute for Prospective Technological Studies-"**Reference Document on Best Available Techniques in the Food, Drink and Milk Industries**" (January 2006)

Partnership

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project coordinator

ttz bio nord

Gdansk University of Technology

DOMECQ Bodegas

InBev

Objective and approach

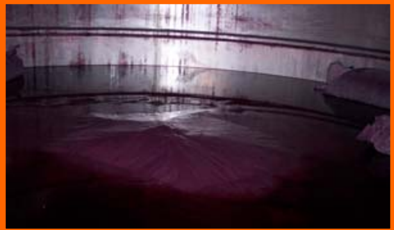
- IPPC Directive encourages clean technologies approaches rather than end of pipe treatments.
- The particular properties of ozone as a strong oxidant and wide spectrum antimicrobial agent lead to its consideration as an interesting choice for C&D with potential environmental benefits in front of other sanitizers.
- LIFE ENV Demonstration projects aim to bridge the gap between research and development results and widespread implementation/market introduction.

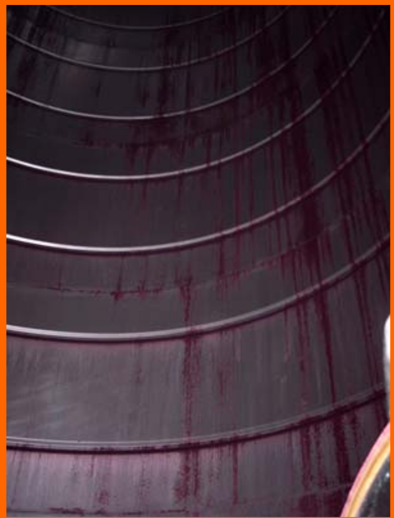
This LIFE project aims to demonstrate that Ozone CIP is a cleaner technology than conventional CIPs

Methodology

A.Preliminary actions. Multidisciplinary background (ozone technologies, CIP techniques, BATs, environmental diagnosis of cleaning operations).
B.Ozonecip prototype. A prototype to simulate conventional CIP processes and essay alternative processes based in ozone
C.Demonstration activities. Simulation of protocols comparing the environmental results obtained when performed with and without ozone.
D.Evaluation of results.
E. Dissemination www.ozonecip.net
F. Management and reporting

In order to enable a high degree of transferability of the results within the food processing industry, demonstration activities will focus on three intensive water consuming key sub-sectors: **winery; dairy & brewery**





Results

Reference range values of the environmental impact of cleaning and disinfection operation were obtained at field work covering the lack of data currently existing at the Reference Document on Best Available Technologies in the Food, Drink and Milk.

Reference cleaning protocols to simulate current practice at food industries and alternative ozone based protocols were designed and performed by means of the pilot plant constructed.

The kind of polluting solutions employed were raw wine inoculated with cultures of micro organisms (acid lactic bacteria and brettanomyces). Beer inoculated with three different types of micro organisms (aerobic and anaerobic bacteria and yeasts), that allowed assessing the specific disinfection efficiency of the applied ozone versus specific bacteria and yeasts cultures likely to be found in beer processing plants: Lactobacillus brevi (aerobic bacteria); Pectinatus cerevisiphilu (anaerobic bacteria); Saccharomyces pastorianu and Candida florica (yeasts). And, the same concept was used regading the dairy related tests in which whole milk inoculated with Bacillus pumilis (Aerobic bacteria), Listeria inocua (Anaerobic bacteria) and accharomyces cerevisiae (Yeast) cultures was used.

Wastewater integrated samples were taken during the cleaning cycles tests. Regarding the Disinfection efficiency RODAC plates sampling and ATP sampling via swab sticks was performed on the inner surface of the vessel before and after the cleaning cycle. Last rinse sampling was also performed in all tests.

Comparative test series were run and comparative environmental indicators from the data obtained in relation to disinfection and cleanliness efficiency and environmental impact set in terms of water consumption and organic load in wastewaters per cleaning cycle.

Results

Environmental data on particular sanitation steps has been collected and confirms that the impact of such operations is significant as the BREF considered qualitatively. Range values for different particular cleaning operations and steps have been obtained. Such data only gives a reference idea of the strength of such wastewaters as manually operated CIPs will make the results variable.

There is not a pattern for the applied amount of water per unit of tank volume, nor for the time the cleaning solutions are kept circulating.

For the three target sectors, the use of ozonated water may lead to a reduction of the water consumption to perform the cleaning protocol of around 50% achieving better disinfection and cleanliness efficiency of the inner surface than with the conventional cleaning cycle tested.

Significant reductions in the organic load of the waste waters produced as a consequence of the cleaning and disinfection operation may be achieved provided first rinse waters with product remnants are recovered first, otherwise ozone would be consumed at this stage without any visible result in environmental terms. Than, the reduction in the organic load in terms of g of COD discharged is more than 50% less for ozonecip system than for the conventional protocols tested. Load reductions achieved are higher for brewery protocols than for winery protocols. Dairy related tests showed the highest reduction in the load present in the waste water.

Performance Indicators of OzoneCIP vs conventional CIP	
ENVIRONMENTAL PERFORMANCE	% Reduction
Water and waste water consumption per cycle (l)	>50%
Organic Load per cycle (g of COD)	>50%
Cleanliness efficiency	same results
Disinfection efficiency	same results

Economic feasibility

Due to the fact that cleaning and disinfection operations are essential and completely unavoidable in the food sector, the economic viability assessment is based on direct comparisons with current CIP systems.

Equipment costs: In addition to the ozone generator a full ozonation system, needs as auxiliary equipment: a gas feed preparation system, ozone generator, injector, reaction tank, dissolved ozone measurement device, ambient monitoring device, residual ozone destructor for the reaction tank and out-gasing system, control unit and circulation pump. The size and cost depending on the actual needs of the installations to be cleaned.

Running costs: When evaluating the exploitation costs that an ozone based CIP will have, the following aspects, same as in conventional CIP systems, are to be taken into consideration:

Energy consumption: Depending on the ozone generator and its ozone production performance, the energy consumption may vary from 80 W (4 gO_3/h) to around 1500 W (40 gO_3/h). These values may vary among different builders. The energy consumption values are negligible compared to any heating system currently used, for heating any cleaning solution. In such cases great energy savings can be achieved by substituting, when possible, hot water or steam disinfection by ozonated water, otherwise hardly any difference will be noticed in energy.

Water consumption: Water consumption is significantly reduced with ozone systems as the disinfection step is done in closed loop and the water is recovered for next use. According to the tests performed a 50% reduction is expectable in most cases.

Chemical consumption: The ozonated water substitutes the disinfectant employed so there will be a direct saving related to the chemical that is no longer employed

Maintenance costs: An important aspect regarding the ozone equipment is the low maintenance costs associated with it. As none of the parts comprising any ozone equipment is consumed, the maintenance work includes little cleaning and calibration work.

Environmental taxes: Currently food processing plants pay taxes that are directly related to volume and to the grade of pollution (measured usually as COD) of wastewater discharged. The discharge tax is determined at municipal level in each European country, with a high variability depending on the plant's location.

Economic feasibility

All parameters mentioned contribute to increase the economical viability of an ozone based CIP system. These parameters and their subsequent economic consequences regarding the plant expenditures versus a conventional CIP system are outlined below:

Parameter	Economical consequence
Reduced water consumption	Less expenses on freshwater
Reduced Energy consumption	Less expenses on energy
Reduced wastewater production*	Less expenses in taxes
Reduced chemical consumption	Less expenses in disinfectants
Increased quality of the wastewater produced	Less expenses in taxes

**Only compared to cleaning and disinfecting with if hot water or steam*

It can be concluded that an ozone based Clean In Place system offers several economical advantages compared to traditional cleaning and disinfection systems currently used in many food processing plants. Ozonecip leads to significant cuts in a processing plant's annual costs. Compared to traditional CIP system's costs, the investment and running cost of the ozonation systems are not expected to be so high. The ozonation equipment itself has been shown to have moderate prices. However, the running costs are much lower compared to tradition cleaning and disinfection systems. This is mainly due to the fact, that water, energy and chemical consumptions, or even taxes related to average costs, and pollution of the wastewater produced, are expected to be drastically reduced by the implementation of ozone CIP in any food processing plant.



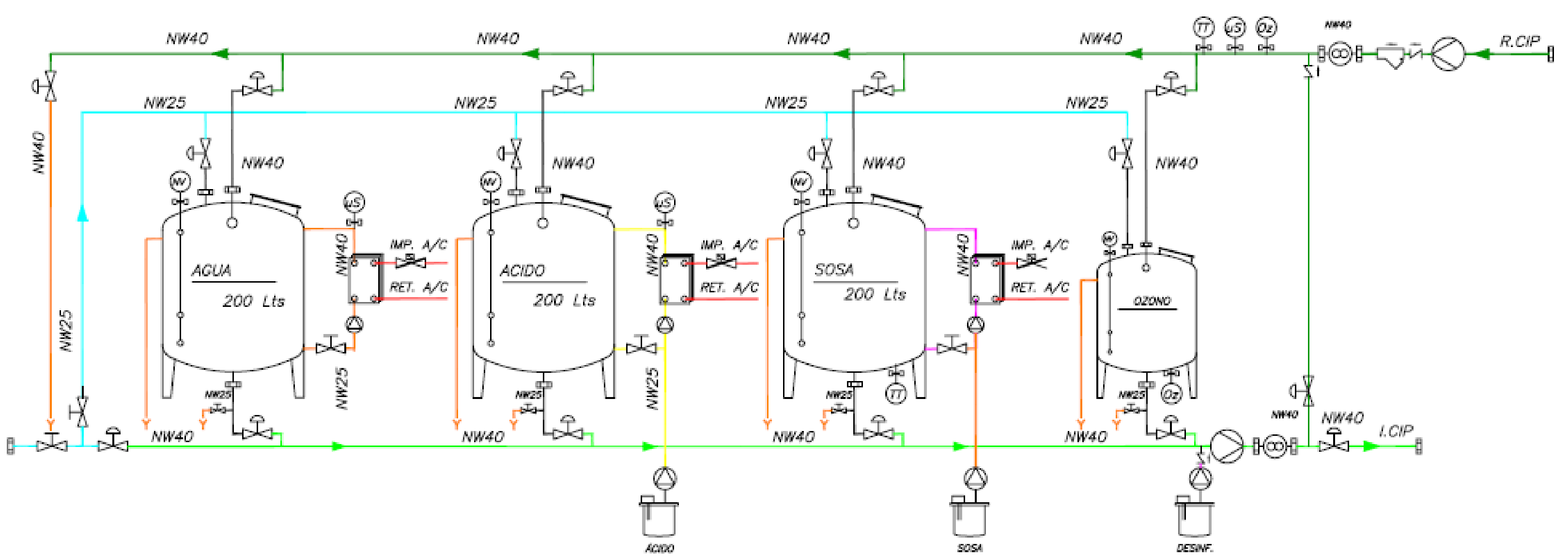

Applicability

The revisions made on CIP techniques and ozone technologies show that an integration of the technologies would be easy and feasible, adopting safety measures to prevent any hazards arisen by the use of ozone and considering material compatibility of installations with ozone, what is not a serious problem as the considered facilities are made of stainless steel 316. In some cases in may be necessary to push ozone accumulated in washed equipment caused by offgasing out of the vessel and destroy it in ozone gas destructors. Cost investment is somewhat high and percentage of the cost in a new automated CIP system depends on its size. Running costs are lower. The economic savings obtained due to water consumption reduction and reduction in the load of wastewaters depend on local conditions and such a balance must be performed for each case. Only in case of avoiding hot water or steam disinfection would the ozone system bring energy savings.

Conclusion

To sum up we can conclude that, according to all the data obtained as a consequence of the implementation of the project the ozonecip system allows a reduction of the water consumption needed to perform cleaning and disinfection operations of closed equipments in the winery, brewery and dairy sectors compared to conventional CIP protocols keeping, at least, the same disinfection and cleanliness efficiency and reducing at least by 50% the organic load in the cleaning waste waters produced. The equipment necessary is available at the market,The investement cost are somewhat higher than current CIP systems and running costs lower. Other considerations such as hazards and material comptatibility are whell identified and documented. Thus. ozonecip technique might be considered as an emerging technology for its consideration as a Best Available Technology for cleaning and disinfection of closed equipment in the Food. Milk and Drink Industry.

The pilot plant



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