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### The Control Yeast & Moulds in Cheese Production

Cheese and mould are always to be found in close association and in some cheeses, such as Stilton, mould is an essential part of the product. In most cheese production however it is an undesirable feature of the maturing process or an unwelcome cause of spoilage so that extensive steps must be taken to prevent damage to the cheese and reductions in yield.

The traditional method of controlling moulds and yeast in the cheese industry has been to use regular disinfectant wash down and fogging. The introduction of the Biocidal Products Directive and other environmental legislation as well as a growing disenchantment towards fogging has led the cheese industry to look for more benign methods that are as effective and a lot easier to use. Ozone has become one of the favoured techniques due to its effectiveness and its rapid decay into natural oxygen leaving no residues. It is also outside the scope of the Biocidal Products directive, as it is generated in situ and as such is being exhaustively tested as a replacement for many of the existing chemical disinfectants.

Ozone is generated by passing oxygen through a high energy corona. This raises the energy levels of some of the bi-atomic oxygen molecules causing them to dissociate into free oxygen atoms. These free atoms then attach themselves to other unchanged bi-atomic molecules creating unstable tri-atomic oxygen that is more commonly called ozone. When ozone comes into contact with an organic substance such as mould, yeast, bacteria or bacteriophage then the ozone dissociates and the free oxygen atom reacts with the cell membrane causing it to burst rendering it inactive. If the ozone comes into contact with a VOC or an odour the free oxygen reacts with the VOC oxidising it into a harmless or non odorous substance.

It was in the 1950s in New Zealand, Australia and the USA that ozone was first used to control moulds and bacteria in the food industry. In 1951 *Walter* demonstrated that mould growth on cheese during curing could be prevented using 1 ppm of ozone.

However reports of its efficacy on cheese varied until more definitive work by *Gibson et al* on Cheddar Cheese was carried out in Canada in 1960. This concluded that at concentrations of between 3 –10 ppm well established mould on cheese could be reduced effectively to zero by exposure for between 14 – 30 days. The mould on the vertical surfaces was reduced to a powdery colourless film while on the horizontal surfaces it took on a light brown scaly appearance. The number of mould spores detected in the room was reduced by 96% when compared with an untreated room. It was also found that even at low concentrations of between 0.2 – 0.3 ppm ozone produced a noticeable reduction in mould. Importantly in all the trials neither the taste nor the structure of cheese was found to have been affected in any way.

Later work by *Shiller et al* in 1974/1978 confirmed these findings by rendering 99% of cheese mould spores inactive using ozone levels of 10ppm.

Much more recent work on yeast at UWIC found that log reductions of up to 5.07 could be achieved after a four hour exposure to ozone at 5ppm with three different strains of *Saccharomyces cerevisiae*. Other workers have found significant reductions in *E. Coli*, and *Candida albicans* in contact with ozone at high concentrations while *bacteriophage lambda* was rendered completely inactive.

Despite this very promising work few if any production installations were recorded in the UK until quite recently as there was little suitable equipment on the market and a general ignorance of how to apply ozone successfully in the food industry. This changed in the late 1990's when Ozone Industries introduced the Corona range of PLC managed ozone generators. This range of innovative generators offered the user a simple and safe method of flooding cheese production and storage areas with ozone during the night and at weekends when people were not present. The development of

sophisticated ozone concentration computer modelling by OIL that has been exhaustively validated by field testing enabled process performance criteria to be programmed into the PLC's that managed the ozonation. This ensured that the appropriate ozone levels were achieved and just as importantly the safety of the overall process was guaranteed.

Ozone Industries now has a considerable number of installations in daily operation in the UK and Eire with companies such as Kerry Foods, Dairy Crest and Glanbia as well as at numerous smaller cheese makers and processors.

One of the main difficulties in the larger cheese plants is the tendency for almost 24/7 working making it difficult to find a long enough regular window in the production schedule to allow for comprehensive disinfection by any method. These high production throughputs bring much higher risks of imported contamination being present either from the transport and storage packaging or from already mould contaminated cheese. This exposure to imported contamination increases the risk of large volumes of contaminated finished product being despatched with the knock on risks of high customer returns and dissatisfaction. Against this background the deep disinfection that is sometimes restricted to once per week is wholly inadequate as the contamination may be brought in early on the Monday morning permitting exposure for a whole production week which might be many tonnes before it is subjected to disinfection. In large plants even disinfection daily can still result in large quantities of contaminated product being produced before the problem is identified.

Against this background Ozone Industries Ltd has recently been developing the concept of continuous disinfection with the aim of keeping any imported contamination under control at all times and so minimising its spread through the plant and into finished product thereby raising overall product quality and customer satisfaction. Recent developments in the control of ozone production and environmental modelling have facilitated this new development. The technique involves the trickling of ozone into the production space on a continuous basis thereby maintaining an ozone level in the room that is well within the health and safety limit guidelines but is sufficient to depress the numbers of moulds and yeasts that may be present. Field trials of this new technique at a very large plant, where cheese was being grated for about 20 hours per day, seven days per week, have shown a reduction in the mould count of 99% and in yeast 80% being readily achieved without any other special action being taken.

This new technique can be tailored to suit any production facility and operating pattern with complete safety. It is highly flexible and can be easily tuned to suit work patterns that have a wide variation in demand. The installation of an ozone disinfection system is simple and straightforward. It requires only a clean, dry and well ventilated space for the generation equipment with the ozone being fed to the point of use by small bore tubes. In most cases a complete installation can be put in without any disruption to production being experienced while the work is carried out.

The Corona range of Ozone Generators and its natural successor the Bravo range have now established a good record of reliability in improving the quality and productivity of cheese production and subsequent processing. These results have been achieved by the reduction of waste due to spoilage and customer returns and with downtime for cleaning reduced by eliminating unplanned deep cleaning delivering increased plant availability and utilisation.

For more information on how ozone can be used to improve cheese production please contact:-

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