

Chemical analysis of cleaning products and guidelines for the effective use of those products for cleaning milking equipment

David Gleeson and Bernadette O' Brien

Choosing a product

- Choose products that are adequately labelled with (a) name of manufacturer; (b) PCS (pesticide control service) number (obtained from Department of Agriculture, Fisheries and Food (www.pcs.agriculture.gov.ie/biocidalproductregisterJanuary2011.pdf)); (c) identity and content of active substances (caustic and chlorine); (d) directions for use (usage rate); (e) optimum temperature of usage; (f) equipment for which the product is suitable; (g) health and safety information; and (h) expiry date and batch number.
- Choose a detergent-sterilizer product with a caustic concentration greater than 10% and a chlorine concentration less than 4.0% (check Teagasc analysis list of cleaning chemicals) if hot water is not used at each milking and the product is to be recycled on one occasion
- Products with lower caustic concentrations are satisfactory if solutions are not recycled for a further wash and if hot water is used for each wash
- Do not stock pile detergent-sterilizer products as the expiry date generally is six months from the date of manufacture

Correct use of products

- Use detergent levels as specified by the manufacturer - use measurement equipment (jug) and check usage rates of automatic washers (machine and bulk tank)
- Hot wash detergent-sterilizers should be used with hot water (9 litres per unit at minimum 70⁰C) at least once daily
- Detergent-sterilizer products (containing chlorine) should be rinsed from the milking system with clean water immediately after the main wash cycle to prevent the chlorine from damaging the rubberware
- When using detergent-only products (powder or liquid caustic with no chlorine), for effective cleaning the stain of the solution should be left in the plant or bulk tank and then rinsed just prior to the next milking
- Sterilizer products (chlorine only) may be used once weekly in conjunction with caustic detergent (powder/liquid products) – as recommended by the manufacturer- should not be used for the main machine or tank wash
- Hydrogen peroxide is recommended by some manufacturers to be used in conjunction with some liquid detergent (non-chlorine) products as part of a good cold/hot wash program
- Descale (acid) wash should be carried out weekly to both machine and bulk milk tank to remove mineral deposits
- An acid wash may be used once daily to replace a detergent wash (detergent in the morning with acid in the evening)
- The use of peracetic acid in the final rinse water may be beneficial where the microbial water quality may be considered an issue. If using peracetic acid in the final rinse water it is necessary to have rinsed out traces of the detergent from the main wash cycle before use.

Recent investigation at Moorepark

Manufacturers/distributors of cleaning products were invited to submit samples of their products to Moorepark for chemical analysis (Irish farmers Journal, 09 January, 2010). Additionally, a large number of detergent-sterilizer samples were sourced on farms. All samples were sent to an independent, accredited laboratory for analysis. All tests of all samples were carried out in duplicate.

Results

Chemical analysis results of the detergent-sterilizer products, liquid caustic only products, caustic powder products and sterilizer-only products are given in Tables 1, 2, 3 and 4, respectively. In Table 1 the chemical results of products are presented in the following columns. Column 1 shows the product name, column 2 indicates a PCS number if the product is registered with the Department of Agriculture Food and Fisheries (DAFF), column 3 indicates the caustic content of products (%), columns 4 and 5 give the working solution strength (ppm) of caustic for each product (based on the manufacturers recommended usage rates and the chemical content of products), column 6 indicates the chlorine content (%) of products with columns 7 and 8 giving the working solutions of chlorine (based on the manufacturers recommended usage rates and the chemical content of products). Products named in Table 1 and Table 2 is listed in order of decreasing caustic content, since this is a main determinant of product effectiveness. The column layout differs slightly for tables 2, 3 and 4.

Interpretation

The success of detergent-sterilizer products in giving satisfactory cleaning can be determined by (i) chemical composition; (ii) usage rate; and (iii) temperature of solution. The detergent sterilizer product may contain adequate levels of caustic and chlorine, however, it is the usage rate or strength of the solution (measured in ppm [parts per million]) during the circulation wash that is most important (i.e. the working solution). The strength of the working solution is a derivative of the main components (caustic or chlorine) content and the mixing or dilution (with water) rate. Other solution components include surfactants as wetting agents which can influence the effectiveness of a cleaning product and sequestrants which act as wetting agents and as an aid to water softening.

Detergent-sterilizers products

Caustic (Sodium hydroxide)

Caustic (sodium hydroxide) is necessary as the main cleaning/detergent agent in products. Detergent-sterilizer products (which contain caustic and chlorine) need to have a minimum of 10% caustic (approximate working strength > 800ppm) if intended to be used in a cold water solution and/or recycled at the next cleaning time, in order to give satisfactory cleaning. A working strength of 800ppm may also be achieved by using a product containing lower caustic levels at a higher usage rate. However, increasing the usage rate to achieve the correct caustic working solution will automatically increase the working solution of chlorine in the wash solution and this can have a negative effect on chlorine residues. A review by the International Dairy Federation has indicated a normal caustic working solution in detergent-sterilizers as between 200 and 800ppm, where hot water is used for the main wash cycle, with no recycling of the solution for a subsequent wash. Therefore it could be expected that products containing less than 10% caustic (200 to 800ppm, working

solution) will give satisfactory cleaning if used with hot water (70°C) and if the solution is not recycled.

Chlorine (sodium hypochlorite)

Chlorine (sodium hypochlorite) acts as the sterilizer agent in detergent-sterilizers products. The preferred chlorine content within a detergent sterilizer product is < 4%, and when used at working solution strength of 200ppm chlorine (hot wash solution) is sufficient for satisfactory cleaning (in the presence of adequate caustic). A working solution of 300ppm chlorine is required for adequate cleaning when cold water is used daily. Chemical residues are more likely to occur if high working solution strengths of chlorine are used, in particular where inadequate rinsing is carried out (a minimum of 14 litres/unit rinse water is required).

Thus, a detergent-sterilizer product of working solution strength greater than 800ppm caustic and up to 300ppm chlorine is required when cold water is used daily for machine cleaning, while a working solution strength of 200-800ppm caustic and 200ppm chlorine is sufficient when hot water is used at each milking with no recycling of solution.

Powder or liquid caustic based detergents (non-chlorine)

A working solution greater than 2000ppm is recommended for cold caustic cleaning products containing no chlorine. A small number of powder products contain chlorine (200ppm) and in these circumstances a lower working solution (800ppm) may be satisfactory for effective cleaning. Detergents may be used cold and recycled on one occasion. Increasing the usage rate will result in higher caustic working solutions. Some products contain high levels of sodium carbonate while other products contain high levels of non caustic alkaline detergents which have additional cleaning benefits. Only marginal differences have been observed in chemical composition of powder products.

Discussion

Typical liquid detergent-sterilizer products used in New Zealand (NZ) contain 15% caustic and 5% chlorine. These concentrations are close to those previously recommended by Teagasc, i.e. 18-21% caustic and 3.5-4.5% chlorine. As observed from this study, caustic and chlorine concentrations range from <1 to 19% and 1 to 10 %, respectively, in the detergent-sterilizer products currently available on the Irish market.

A relatively high concentration of caustic (>15%) in a detergent-sterilizer product will allow for lower usage rate while still achieving effective cleaning. Typical usage rates of such a product in NZ (200ml/50 litres) are considerably lower than what is generally used in Ireland; furthermore, hot water is used twice daily and detergent is not recycled for the subsequent milking in NZ. Alternatively, in the Irish context, hot water is used less frequently and the cleaning product is often reused more than once. Detergent-sterilizers with relatively high chlorine and low caustic contents often do not give satisfactory cleaning. This may lead to even more chlorine being added to the detergent-sterilizer solution by the milking operator, in an attempt to achieve more effective cleaning. This will not normally improve cleaning sufficiently and may also result in unwanted chlorine residues in milk.

Correct usage rate of the detergent-sterilizer and temperature of solution are crucial for satisfactory cleaning. In many instances manufacturers clearly state that a detergent-sterilizer product be used as a hot wash solution, but milking operators use it cold on a daily basis, thus resulting in sub-optimal cleaning. Adequate hot water (9 litres/unit at 70 – 80°C) used at least once daily can result in satisfactory cleaning with lower levels of detergent-sterilizer (compared to cold cleaning) and less risk of milk residues. Heating water once daily particularly the use of night rate electricity can be more economically efficient than the higher chemical usage associated with cold detergent-sterilizer cleaning.

In conclusion, the range of products tested and reported on in this article may not include all of the products on sale in Ireland for the purpose of cleaning milking plants and it is not intended for use as a ‘recommended list’ of products.. It is anticipated that this study will assist dairy farmers to make an informed decision on which products are most suitable for the task required and are the best value for money.. The product range tested will be amended and updated as new products are introduced, as manufacturers modify the chemical content of their products and as the product registration status is established.

