



The University of Hong Kong

SAFETY MATTERS

Superheating and safe use of autoclaves

Recently an incident was reported in which a post graduate student experienced a significant injury when retrieving a bottle from an autoclave. After retrieving the bottle and placing it on a surface with the intention of allowing it to cool down it exploded in their hand when they attempted to adjust the bottle cap. The design of autoclave used permitted the chamber to be opened and the contents retrieved when the chamber temperature indicated more than 90°C. The load had been prepared correctly, with the cap loosely positioned so as to permit entry of steam to sterilize the bottle contents. However the autoclaving process, which involves a combination of heating and pressurizing the chamber load, can on some occasions leave liquids superheated. In this state water or salt solutions without solid residues can remain in liquid form above 100°C. Any slight disturbance, such as in this incident adjusting the bottle cap, causes the water to suddenly transit to gas phase (its equilibrium state above 100°C at atmospheric pressure) with a violent release of energy.

See here for an explanation of the phenomenon

<https://www.youtube.com/watch?v=VfyTELj5cOQ>

See here for a demonstration

<https://www.youtube.com/watch?v=LpDs7Xm1uLo>

Possible contributory factors were working very late in the evening and working while very hungry and tired, which increased the desire to work quickly and may have impaired judgement about risk.

Learning from this incident:

1. The process of autoclaving can leave liquids superheated. In general autoclave loads should be allowed to cool before accessing them. If superheating cannot be avoided by other means anti-bumping granules can be added to liquids to prevent superheating.
2. Unsafe conditions do not always lead to an accident, which means that it is possible to perform a dangerous act more than once without realizing that it is dangerous. Training and codes of practice if followed consistently reduce the chances of an accident in situations where hazards are not immediately apparent.
3. Preparing loads for autoclaving and retrieving loads from autoclaves requires training.
4. Working under stress, whether late at night, tired, hungry or under significant time pressure (or any combination of these) increases the risk of poor decision making or fatigue leading to accidents. Even if there is no accident, if the task fails and needs to be repeated you may overall spend more time completing it than if you worked to a more sustainable schedule.

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