6. Machinery

6.1. Heating

6.1.1. Pasteuriser

For design of pasteurisers the same recommendations are valid as for other equipment (see chapters 2 and 3). Surfaces should be smooth and easily cleanable and valves couplings, sensors etc. should not contain any dead ends.

When the temperature in the pasteuriser becomes too low, the flow must be diverted to the balance tank.

In this setup, the distance between the temperature sensor and the diversion valve must be large enough to ensure that all insufficiently treated product is diverted to the balance tank when the temperature is too low.

Figure 6.1 Plate heat exchanger .

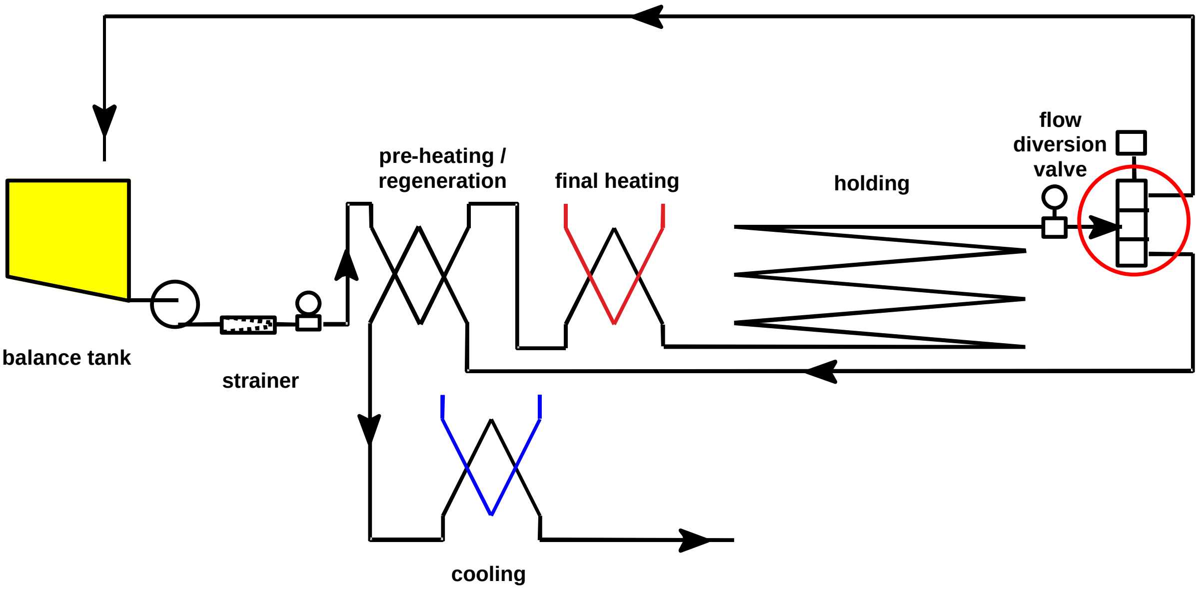


Figure 6.2 Setup of pasteuriser with temperature controlled flow diversion and balance tank .

Valves downstream the heating section should be aseptic to prevent recontamination of the product. For flow diversion, either two single seat valves or one double seat valve can be used.

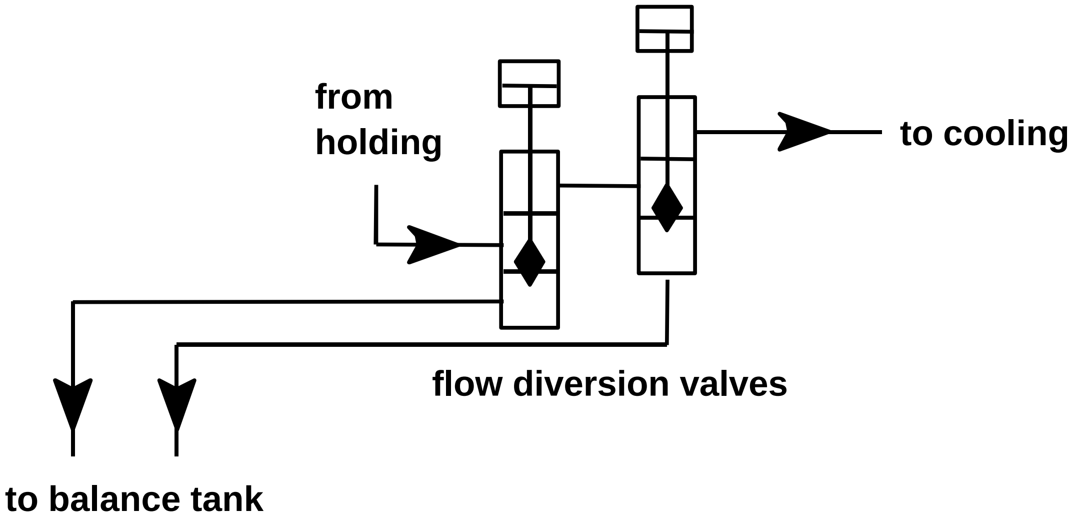


Figure 6.3 Set-up for flow diversion using two single seat valves .

The set-up using two single seat valves is depicted above. When the first valve is leaking, the second one will divert the flow back to the balance tank.

Scheme of operation before, during and after an insufficiently high temperature is registered;

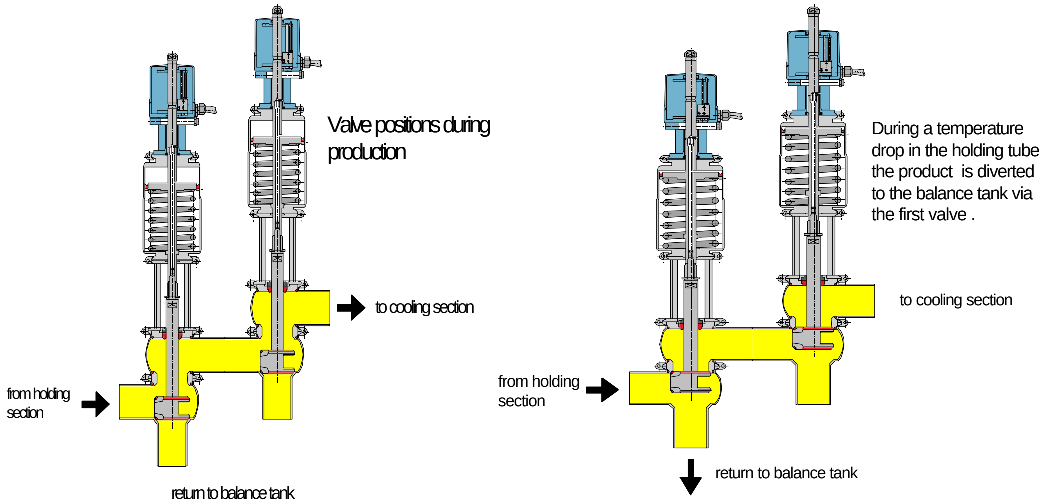


Figure 6.4 Normal operation (left). After detection of a problem (like insufficient heating) both single-seat valves are closed (right). The product flow is diverted to the balance tank.

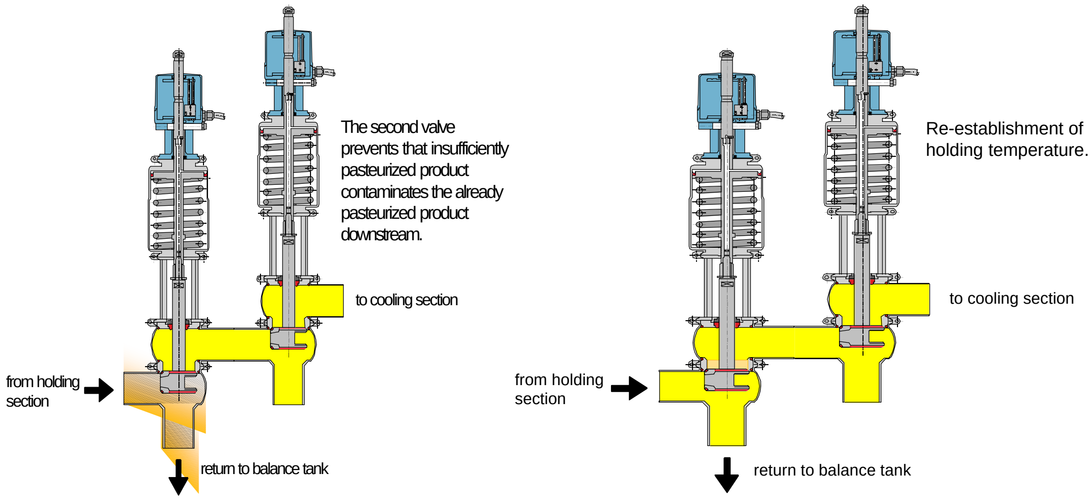


Figure 6.5 The insufficiently heated product is diverted to the balancing tank (left). The dead volume between both valves is not flushed yet. When the correct temperature has been re-established the first valve can be closed again.

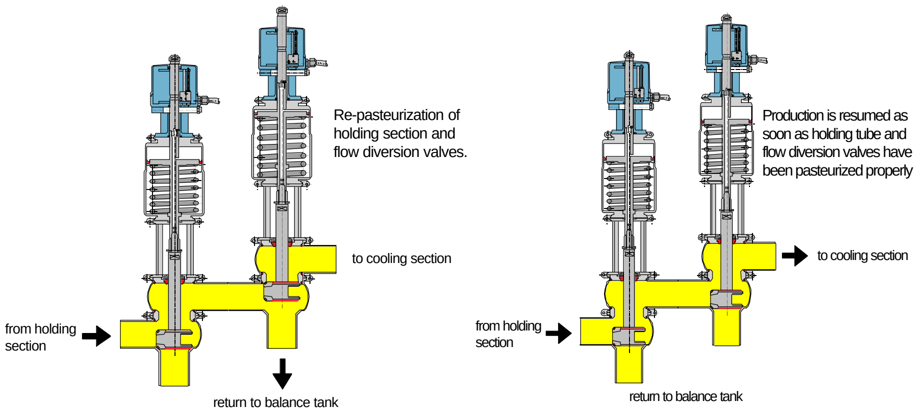


Figure 6.6 The formerly dead space is now rinsed (left), discharging its contents, after which normal production can be resumed (right).

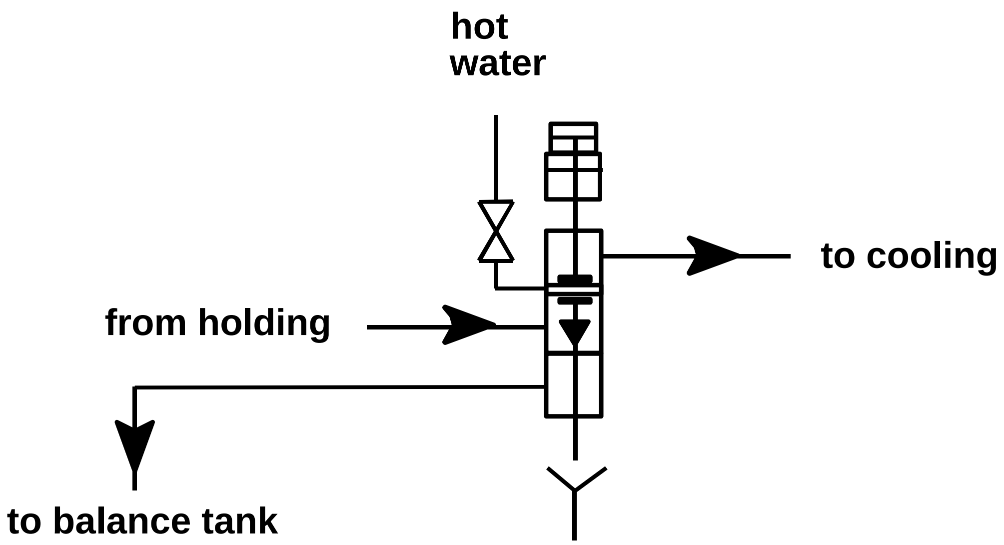


Figure 6.7 Set-up for flow diversion using one double seat valve .

The set-up using one double seat valve is depicted above.

The scheme of operation before, during and after an insufficiently high temperature is registered is given in Figure 6.8 and Figure 6.6.

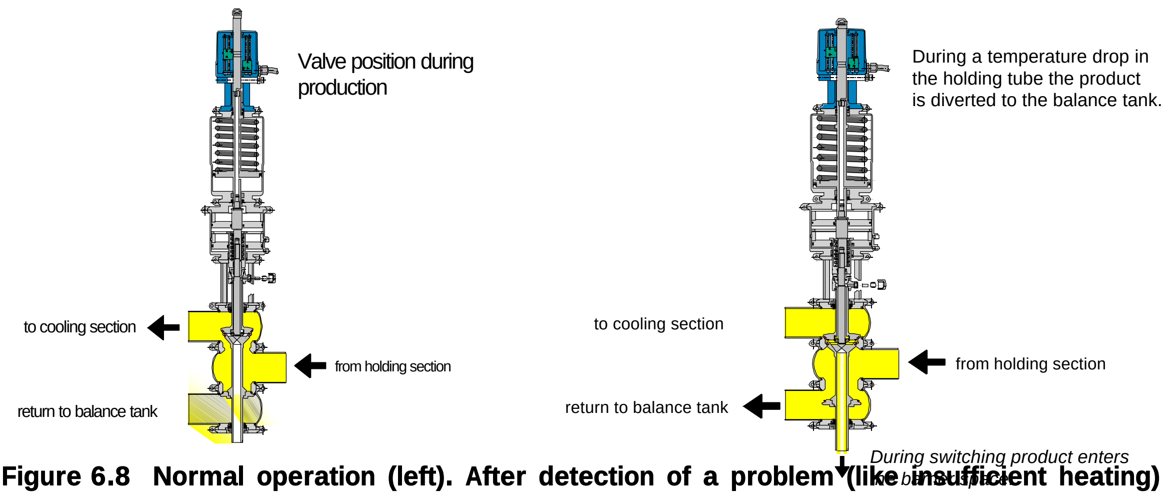


Figure 6.8 Normal operation (left). After detection of a problem (like insufficient heating) the product flow is diverted to the balance tank.

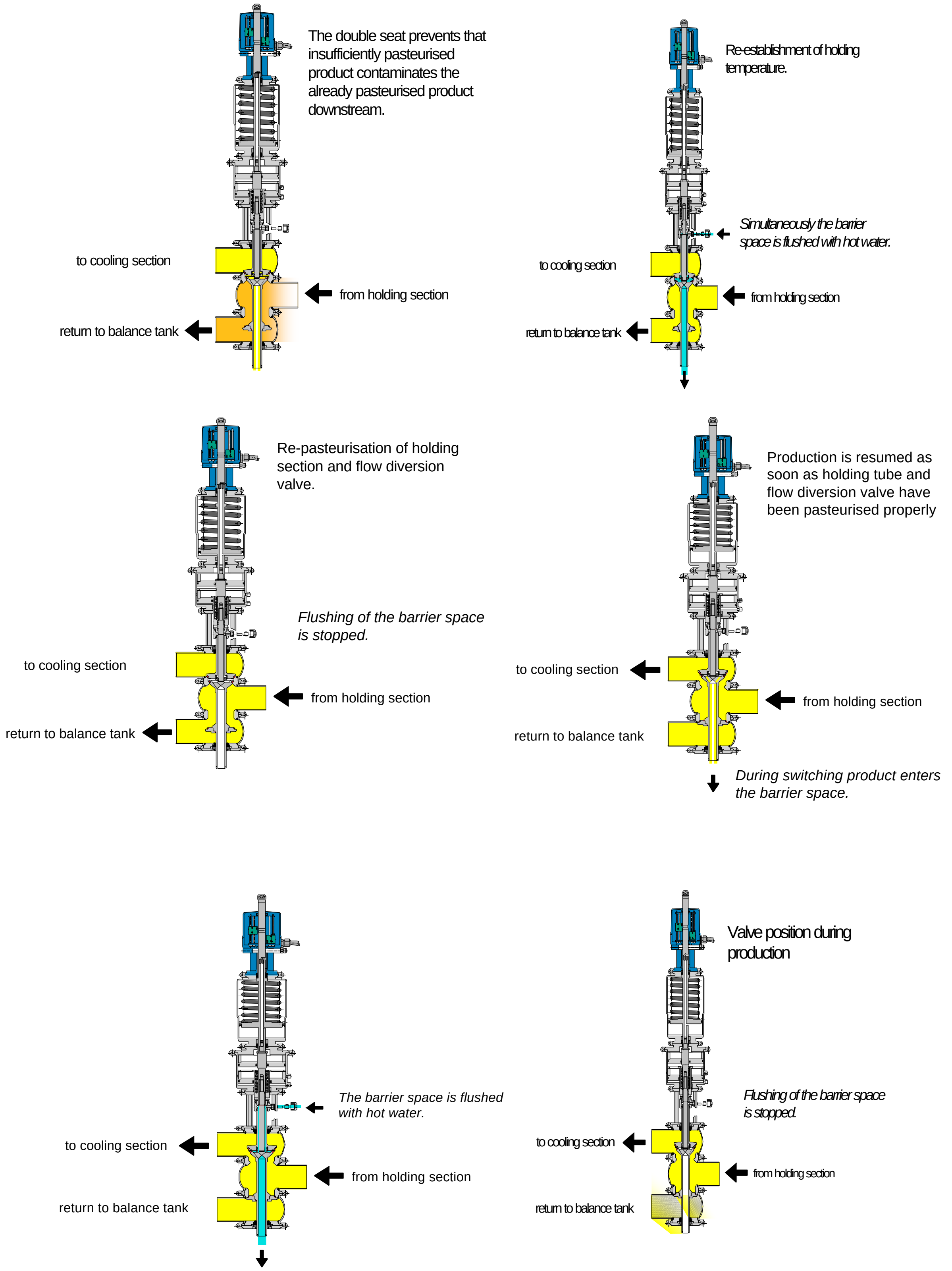


Figure 6.9 Sequence of six steps from diverting flow to restoring normal operation, using a double seat valve. As (contaminated) product may reach the valve internals, they have to be flushed to ensure no product that should have been rejected can pass (to the cooling section).

More information can be found in document 1 EHEDG.

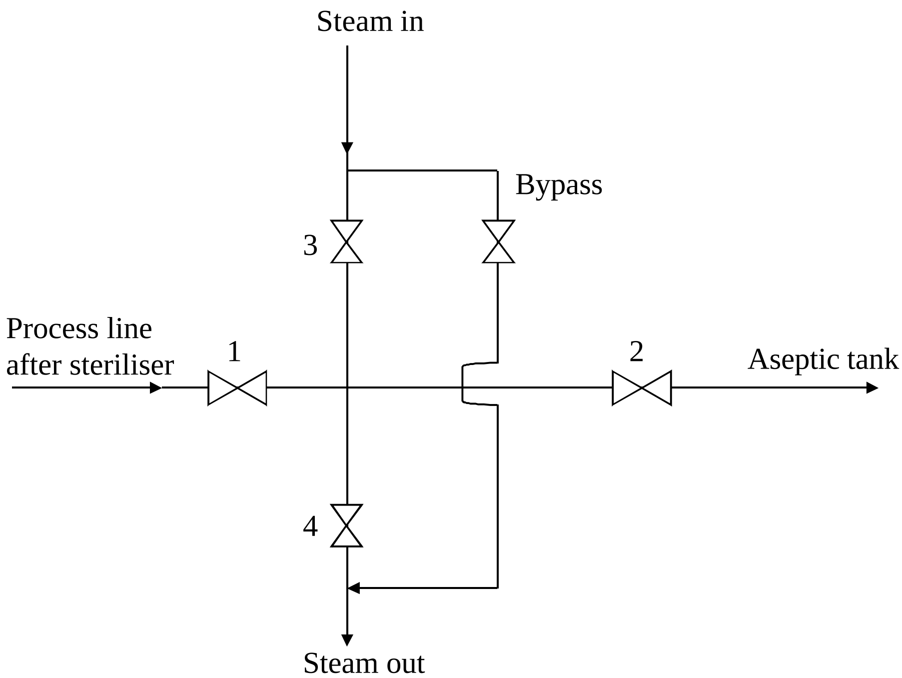
6.1.2. Steriliser and aseptic barriers

The same requirements are valid as for a pasteuriser. After the heating section, conditions should be aseptic to prevent recontamination. This means that air filters should be used to keep balance tanks aseptic.

Sterilisation can take place directly (through steam injectors or steam infusion) or indirectly (using heat exchangers). When steam injectors are used, the injection nozzles should be cleanable and no chemicals should be left in the steam supply line after cleaning.

In contrast to pasteurisers, product is usually not recycled after a temperature drop due to the negative effect of extensive heating to the quality of the food product. Product is, however, blocked after a temperature drop using aseptic barriers to keep product in the buffer tank sterile while the rest is unsterile.

Aseptic barrier in a process line:



When the plant and tank are sterile, valves 3 and 4 are closed and 1 and 2 are open. If the process plant becomes unsterile (temperature too low) valves 1 and 2 are closed to protect the product in the aseptic tank. Valves 3 and 4 are opened and steam purges the pipe section between valves 1 and 2. A bypass line is needed to steam the back of valve 4 so that no recontamination through this valve can occur Aseptic barrier.wmf (from doc 12, EHEDG).

Instead of an aseptic barrier as shown above, a double seat valve can be used as well (see 6.1.1). More information can be found in EHEDG document 6.

6.1.3. Sterilising particulate foods

The same requirements are valid as for liquid sterilisers. The difference with sterilising particulate foods is that for the latter higher temperatures or longer sterilising times are necessary to reach the right temperature in the centre of the particles. This may thus lead to overprocessing of the liquid phase resulting in loss of food quality. Separately sterilising fluids and particles can overcome this problem. The effectiveness of the particle steriliser cannot be checked using temperature sensors since these can not measure the centre of the particles. A method that can be used to check sterilisation is attaching bacterial spores (e.g. Bacillus subtilis) to the particles and count the number of spores before and after sterilisation. More information can be found in document 12 EHEDG.

6.2. Packaging

When pasteurisation or sterilisation has been done correctly, packaging should not cause unacceptable recontamination. For products with short shelf life, cold storage or products that get an in-pack heat-treatment, hygienic packaging is sufficient. Products that require a longer shelf life at room temperature need to be packed aseptically.

Figure 6.10 Packed products leaving packaging machine.

6.2.1. Hygienic packaging

Requirements for packaging machines and environment are the same as for other equipment (see chapters 2, 3 and 4). Recontamination must be prevented through:

- Maintaining a clean and tidy environment.
- Assuring short exposure times by fast filling and sealing of the product.
- Controling air quality using filters (see chapter 4.8)
- Covering exposed products and open packaging materials (Figure 6.11).

Figure 6.11 Covered product line.

6.2.2. Packaging material:

Packaging materials must meet microbiological requirements (achieved with H_2O_2, heat treatment or UV) and must be of good quality. Damaged packing material not only may cause leaking of product, but can also lead to product contamination. In general:

- Only a minimum amount of packaging material should be stored near the packaging machine.

- The storage room for packaging material should be appropriate with regard to humidity (as dry as possible) and hygiene (no contact with personnel (hands) or pests).

Figure 6.12 Wrong: bird droppings on box in storage: a hygiene risk, as contamination may be spread to contents of box when unpacking.

Figure 6.13 Correct: packaging material sealed in plastic and stored in a clean environment.

More information can be found in EHEDG document 11.

6.2.3. Aseptic packaging

The same requirements are valid as for hygienic packaging. Furthermore, aseptic packaging machines must be bacteria-tight so that the product can not be recontaminated.

Packages must be sealed properly so that no leaks can occur. Parameters for sealing must be appropriate to obtain a safe seal (sealing time, temperature and pressure). These parameters must be monitored to control the sealing process.

More information in EHEDG document 3.

6.3. Further reading

1. H.L.M. Lelieveld (2000). Hygienic design of factories and equipment. In: Lund, B.M., Baird-Parker, T.C. and Gould, G.W. Microbiological safety and quality of food 2. Aspen Publishers Inc. Gaithersburg, 1656-1690

EHEDG guidelines:

2. Document 1: Lelieveld, H.L.M., Hugelshofer, W., Jepson, P.C. et al. (1992). Microbiologically safe continuous pasteurization of liquid foods. Trends in Food Science & Technology 3(11), 303-307

3. Document 3: Mostert, M.A., Buteux, D., Harvey, P.C. et al. (1993). Microbiologically safe aspetic packing of food products. Trends in Food Science & Technology 4(1), 21-25

4. Document 6: Hasting, A.A., Jepson, P.C., Lalande, M. et al. (1993). The microbiologically safe continuous flow thermal sterilization of liquid foods. Trends in Food Science & Technology 4(4), 115-121

5. Document 11: Mostert, M.A., Schießl, S., Rysstad, G. et al. (1993). Hygienic packaging of food products. Trends in Food Science & Technology 4(12), 406-411

6. Document 12: Hasting, A.P.M., Davies, S.A., Lalande, M. et al. (1994). The continuous or semi-continuous flow thermal treatment of particulate foods. Trends in Food Science & Technology 5(3), 88-95