# VALVES IN THE FOOD AND BEVERAGE INDUSTRIES

*In the food industry there are, apart from product lines, also other lines such as auxiliary CIP lines, water-supply lines, waste-water lines, lines for air, gas and heating media (mostly steam, but also hot water or other thermal media).*

The specifications for valves used in these branches of industry are as varied as the media themselves. Essentially, we differentiate between valves in accordance with

Specifications
- Shutoff function
- Backflow prevention
- Pressure-stabilizing action
- Protection against over- or underpressure
- Pressure- or volume-regulating function
- Sampling

Types of valve
- Seat valves
- Ball valves
- Butterfly valves
- Gate valves, etc.

As a rule, not only the basic suitability of a valve is of importance; also aspects of an economic nature play a part in the selection process. Apart from the price of the valve itself, one has to consider installation and maintenance costs as well as the risk and the consequential costs of a failed valve. As far as suitability is concerned, first of all we have to turn our attention to the location. Valves in lines carrying product or media coming directly or indirectly into contact with product should be satisfactorily suitable from a hygienic point of view. $CO_2$, nitrogen or compressed-air lines, CIP, auxiliary and product water lines ought to be designed and constructed according to the same principles as product lines. Contrary to theory, valves are normally selected on the basis of experience. In most cases, this modus operandi produces results that satisfy all those involved in the process. Of course, the latest findings, for example concerning sealing materials, and in particular those on new valve designs, play absolutely no part in the decision-making process. Tables showing temperature (Tab. 1) or chemical stability (Tab. 2) are only of limited assistance in selection. Most product, CIP and gas lines are operated at temperatures ranging from 10°C to 90°C, whereby steam lines reach a maximum of 110°C and the data on chemical stability are only of limited practical value.

**Tab. 1:**

| Material | Temperature range |
|---|---|
| MVQ (transparent) | +40 up to +110° Celsius |
| MVQ (red) | +40 up to +110° Celsius |
| FKM (Viton) | – 5 up to +200° Celsius |
| HNBR | –30 up to +150° Celsius |
| EPDM | –40 up to +130° Celsius |

**Tab. 2:**

When selecting the most appropriate material for elastomer seals, it is not only important to take into account the required physical properties, but also to consider the degree of stability in conjunction with the various production media. The suitability of any elastomer is determined on the basis of source values obtained by dipping the material in the relevant medium for a defined period of time at a preset temperature. These source data provide an indication of chemical/physical change. Stability can therefore, for example, be defined as follows:

**Score 1** = Source rate less than 10 % by volume. Certain temperature and pressure conditions can result in lower physical values.

**Score 2** = Source rate between 10 and 20 % by volume. The resultant reduction of physical values can already lead to failure.

**Score 3** = Source rate between 20 and 40 % by volume; the concomitant deterioration of physical values would probably result in failure in dynamic applications. Could be used successfully in some static applications, but this should be checked beforehand on an individual basis.

**Score 4** = The elastomer is unsuitable for this medium.


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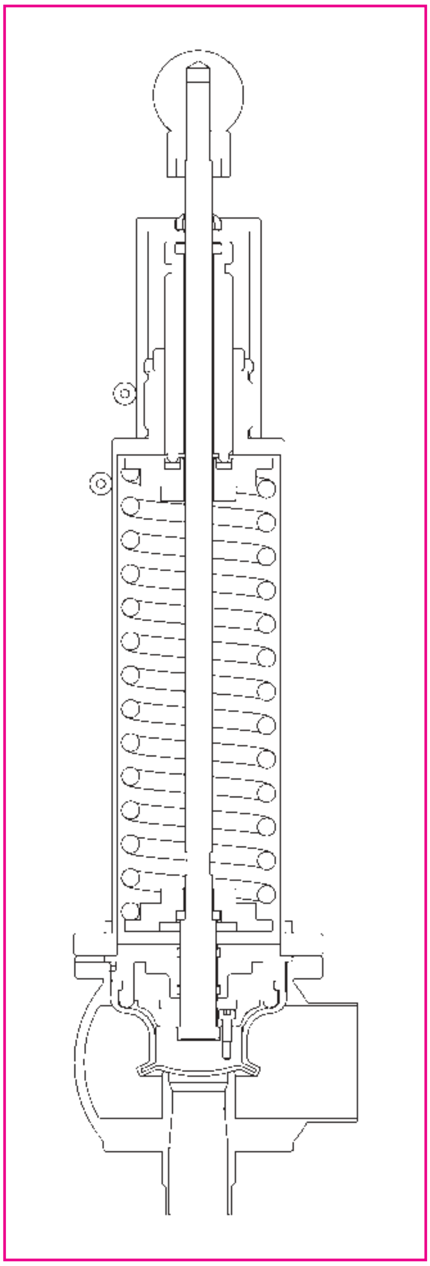

**Fig. 2: Full-stroke pressure relief valves can reduce some problems.**

System engineers or suppliers of detergents should always be able to make a proper selection of elastomer materials. Manufacturers of system fittings can only be of assistance in such cases if they are totally familiar with the application, in other words, if the operating conditions are precisely defined. When selecting the proper valve for the specified application, on the other hand, it is quite possible to encounter a few additional problems:

– The end customer is not always in a position to properly assess information provided by the prospective supplier.

– The supplier is marketing a product that he has selected according to economic considerations most favourable to himself.

– The prospective supplier manufacture fittings himself and only offers his own products, even if they are only suitable to a limited degree for the application in hand.

In case of doubt, the wise course is to trust in renowned manufacturers. Sometimes, there are only compromise solutions for even the apparently most simple application, a fact that we would like to demonstrate in a short résumé using a few new developments as examples. Backflow breakers or non-return valves are designed for the beverage industry mostly in the form of spring-loaded, non-return. The user has to live with the following design-related problems:

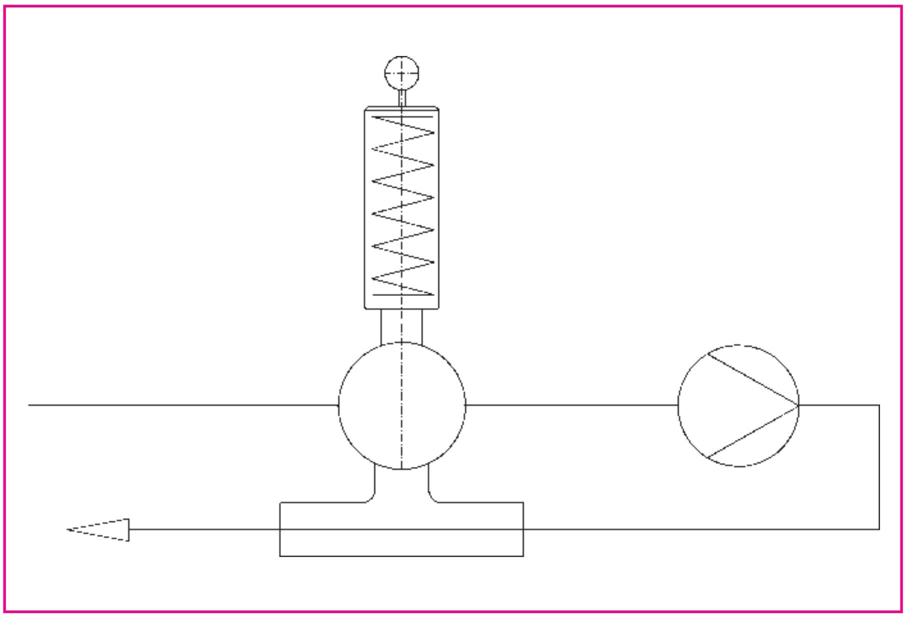

**Fig. 3: Overflow valves are installed to protect forced-feed pumps.**

– Detachable pipe connections must be fitted to enable valves to be dismantled;

– In the area around the spring is a microscopic gap or fissure that cannot be cleaned;

– It is impossible to check operability (jammed, for example by foreign matter or failed seal) without dismantling;

– Depending on the structural design, the installation orientation can impede function;

– As the flow rate increases, the spring causes a rising loss of pressure;


**Fig. 4: Aseptic diaphragm pressure-maintaining valve.**

– Deliberate passage against the normal direction of flow is not possible without dismantling.

Based on their aseptic-valve programme, Nocado have developed a check valve that causes none of the above-mentioned problems. We have even fitted a mechanical control device for backflow that is accessible from the outside (see figure on the left). The diaphragm and a suitable degree of pre-tensioning provide the valve with full-stroke capacity, i.e. after overcoming the initial pressure, the valve opens completely with a correspondingly low loss of pressure. Since the entire mechanical assembly is accessible without having to dismantle the valve, it is possible to weld the valve in position. A leakage outlet is used to monitor the seal diaphragm. Limit switches provide feedback on valve positioning. The valve is fully aseptic and suitable for applications in conjunction with gases and fluids, even in explosion-proof areas.

Safety valves are usually installed in vertical orientation. The valve stem is subject to friction; for example in the event of horizontal installation, response could be adversely affected. In most cases, the decision against the installation of full-stroke pressure relief valves is made on cost-saving grounds. Other protective measures are then adopted to try and prevent liquid passing through the safety valve. Full-stroke pressure relief valves (see figure 2), the aseptic versions of which may also be installed in horizontal orientation, can reduce some of the problems because, especially in the case of safety valves, it is more advisable to install less reliable equipment that operates purely mechanically and efficiently than systems that are becoming increasingly more complicated.

In terms of structural design, overflow valves and pressure-maintaining valves are the same. Overflow valves, for example, are installed to protect forced-feed pumps. The upper section of the housing is connected to the suction side of the pump, and the lower section with the delivery side (see fig. 3). When operating as designed, the valve is fully closed, liquid flows through the entire pipe system, and there are no dead spots. If, for example, as a result

**Fig. 5: Aseptic sampling valve.**

of faulty operation, the pressure at the outlet rises to a level above the admissible limit, the valve opens and prevents any further increase in pressure, thus protecting the system from certain damage.

When carrying out cleaning operation, it is possible to signal the valve so that the flow volume in the main line is not reduced by the forced-feed pump.

Pressure-maintaining valves are installed in pipework at corners or in inclined orientation to maintain pressure at a constant level. Typical applications are, for example, at the discharge end of flash pasteurizers, where they prevent the release of dissolved gases or the formation of steam bubbles, or as bunging apparatus that bind $CO_2$ in beverages during the fermentation process. Standard pressure-maintaining or overflow valves are neither equipped with a leakage-monitoring function to report seal failure, nor are they aseptic. The figure 4 shows an aseptic diaphragm pressure-maintaining valve.

Sampling valves tend to be "forgotten" by system engineers. Really good sampling valves can be

– opened manually for sampling and

– automatically for cleaning;

– sterilized;

– cleaned;

– are reliable, but unfortunately also

– expensive and

– as rare as pandas.

Of course, an overview of this kind can only illustrate a very small portion of the multitude of equipment available; in most cases, what has withstood the test of time is also the best. □