Sampling systems: maintaining quality and safety

The need for representative samples plays a critical role in ensuring product verification. Yet sampling directly from the process often includes the risks of exposure to the operator as well as contamination and pollution to the environment. The DOPAK® sampling method reduces such risks with its patented design and simple method of operation.

Figure 1

The DOPAK® sampler (Figure 1) solves the problem of taking samples of toxic, dangerous and volatile substances as the operator is well shielded from contact with the product being sampled. Local spillage can be avoided and volatile substances will not escape into the atmosphere.

In its simplest form, the sampler consists of a valve, needle assembly and protective sleeve. The needle assembly is attached to the valve and houses a pair of finely honed needles. One needle accepts sample from the process: the other acts as a means to vent.

Operation

Figure 2 illustrates the steps of operation. The sampler is installed directly into the process via a connection on top the valve. A sample is drawn from the process and arrives at atmospheric pressure in the sample container. This container consists of a glass bottle with a threaded, open-top cap. Between the bottle and cap a self-sealing diaphragm (septum) is placed (Step 1).

The bottle, with cap and septum, is inserted into the sleeve until the needles extending from the needle assembly (Step 2) pierce the septum. Once in position, the operator opens the valve, allowing product to flow into container (Step 3). When the required amount has been taken, the operator closes valve and the bottle is pulled out of the sleeve. The septum is of such material that when pulled from the needles, it reseals automatically (Step 4). The bottle is then taken to the process laboratory for evaluation. The sample fluid can be extracted from the container via a syringe thereby reducing or eliminating exposure of laboratory personnel to the sample fluid. Then the evaluation is complete, the entire contents can be disposed of in the still sealed container.

Needle assemblies

The DOPAK® Sampler design centres on the needle assembly. It consists of a housing in which two needles are mounted. In standard practice, the longer needle is used to vent out the air displaced by the incoming fluid, which is sometimes mixed with gas or vapour. Two venting models are available. The VTA design (vent to air) allows the air from the bottle to be vented directly to the atmosphere. The VTO model (vent to outlet) provides a fitting connection to the vent needle. In this way the vent needle can lead to a waste system, wet collector, scrubber, activated carbon container, or back to the process if the process pressure allows. The DOPAK® sampling system does not allow for a high-pressure build up in the container or a total blockage of the vent outlet. If this happens, the septum would open up somewhat resembling a safety valve. Because of this, placing valves in the vent outlet should be avoided. If required, a check valve could be installed in the vent outlet. The purpose is to prevent any unwanted backflow of the waste system when the sampler is not in use.

One-handle operation

DOPAK® sampling systems are still based on the basic DOPAK® principle of filling a sample into a sealed sample container. This can be either a bottle, sealed with cap and septum or a
cylinder. Whenever a DOPAK® sampling system requires more than one valve, it is considered whether operation technically can be done by one handle. In DOPAK®’s opinion, one-handle operation ensures greater safety, avoiding sequence-mistakes in operating more than one valve during the sampling operation. In most cases, even an interlock-feature could be added to ensure access to the system and/or to guarantee the correct sequence of various steps in the sampling operation.

**System 23 and System 32**

The group of systems has been divided into two ranges, System 23 and System 32. All System 23s have been designed with a predefined volume sample chamber. System 32s generally lack a sample chamber. They are more geared towards the use of a standard DOPAK® Process sampler with an additional valve that is operated in conjunction with the main valve. Combinations of a System 23 and a System 32 are feasible. Both use more than one valve. In the case of the System 23, the valves are internally coupled through the sample chamber. The System 32 is different in that valves are externally coupled.

The System 23 has been designed to enable sampling of predefined quantities of fluids independent of the process pressure or installation. The system can be used regardless if operated under vacuum or high pressure. The system 23 is built with a sampling chamber that can be shut off simultaneously at both ends with two three-way valves. Both valves are connected in such way that they are operated by one handle. With continuous flow through the sample chamber i.e. system purge, a fresh sample is assured. This cleans both the process piping to the sampler especially that of higher viscosity fluids when an inert purge is not able to completely remove 100% of the fluid contained in the sample chamber (Figure 3).

With Dopak’s principle the sample fluid will end up at atmospheric pressure inside the sample container, regardless of process pressure or vacuum condition. With the System 23, the sample fluid can be circulated through it at a high pressure or under a vacuum. The inert purge than removes the sample from the System 23 at a pre-set pressure. The volume of the sample chamber decides the volume of the sample. This volume has to be specified when ordering the system. The factory has chosen a range of standard volumes. Any other size can be supplied on request.

**Special models**

Figure 4 shows a System 23 with a cooling jacket around the sample chamber. The jacket is suitable for water-cooling and constructed form the same material as the System 23. It is possible to leave the sample in the sample chamber to let it cool off to ambient before it is transferred into the sample container. However, the purpose of this design is to lower the temperature of the sample when captured in the sample chamber quicker before it is transferred into the sample container. Some fluids like hydrogen cyanide (HCN), require welded or flanged connections through-out the process installation. The System 23 has to be adapted to meet this requirement. The operation is no different from the standard system.

All process connections to the valves are welded. The sample chamber is split in two parts and welded to the valves. It is flanged together to enable access to interior parts of the valve for maintenance. The application of a split-body sample chamber can come in handy when the sample material could inadvertently solidify and the sample chamber must be cleaned regularly.