Non-return valves for intermediate pumping stations of wastewater containing faecal matter

Section IV. New applications of the new valves

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Fluid mechanics versus wastewater pumps and fittings

Most of the companies manufacturing equipment for wastewater pumping stations focus on pump solutions, forgetting non-return fittings, whereas the fittings sometimes determine the opinion that the pumping assembly (intermediate pumping station) user has of the manufacturer, depending on the problems caused by the fittings installed on the pump outlet pipe. The issue also refers to manufacturers and suppliers of intermediate pumping stations.

What makes a wastewater pump more advanced than standard return fittings for wastewater, as far its construction is concerned? The answer seems simple – the fact that the problem is underestimated, but not only that. It also results from the fact that some companies manufacturing potable water fittings do not fully understand the significant difference between media. No doubt pump construction engineers form the elite group that values new sealing, drive and control solutions. But this elite grew on the construction of potable water and central heating pumps as well as technological water used in industry. A rapid development and progress of pumps for wastewater containing faecal matter is a recent development that began in the 1960s in Western Europe and in highly-developed countries (in the 1980s in Poland). However, a rapid development of submersible wastewater pumps did not entail the development of non-return wastewater fittings. As if that was not enough, a lot of manufacturers approached wastewater pump construction without any humility and did not appreciate such a predictable medium as municipal wastewater. It appears that the wastewater composition not only depends on the number of serviced inhabitants but also on the land topography, weather, season, local customs, cultural level of the system users and also on the cultural level of servicing the whole sewage system. What makes the situation even worse is the fact that many pump manufacturers do not employ specialists in fluid mechanics, especially in hydrotransport. The companies that have such specialists usually deal with servicing the industry, where they can get more money easily. This behaviour is appropriate, since if they wanted to enter a new technical sector, they would have to employ specialists in the construction and maintenance of sewage systems. But the companies (especially small and medium-sized) that are not able to exist in the industry, are looking for their place in the sewage market with different results. Obviously, there are large international pump concerns that have taken over or bought pumping companies specialising in wastewater, so as not to learn from mistakes. A lot can be learned from specialists working in the companies, especially as far as problems with non-return wastewater fittings are concerned and also what reliable, self-control fittings they look for.

Innovativeness

Peter F. Druckner writes in his bestseller “Innovation and Entrepreneurship” [1]: “Innovation, like any other undertaking, also requires emotional compatibility. Companies do not have good results in something they do not respect. Similarly, pioneers have to be emotionally tuned for the occasion of innovation. It has to be important for them and make sense. Otherwise they will not be eager to devote themselves to persistent, hard and frustrating work, which successful innovation always requires.”

If some specialists – construction engineers from the pumps for faecal wastewater sector – neglect the field of non-return wastewater fittings, we should not expect them to introduce anything significant in the field.

Moreover, in cases where the forces of nature have to be used perfectly and all conditions for a reliable functioning of such a difficult medium as faecal wastewater should be considered, what is necessary, besides technical and organisational skills, is hard and strenuous work, faith in success and intuition. Proper setting of targets and the ways to attain them is also of major significance.

New solution

The situation changed when a new construction of a non-return knee ball valve appeared. It is slowly changing the construction of intermediate wastewater pumping stations, pumping stations with a dry chamber (with a preliminary separation of solid matter, called pressing stations, and without the separation of solid matter).

Although in 2005 only few innovators were interested in non-return knee valves for wastewater, nowadays interest in the product is much greater. What does it result from? A product that is supposed to comply with the requirements of European norms [2] requires a series of laboratory tests of models, prototypes and equipment specimens as well as conducting the tests in real conditions for every diameter, which makes the period of its implementation for production longer. The goal was reached in May 2006 and as a result the non-return knee valves manufactured in quantity in the diameter range of DN32 to DN200 (and finally to DN300) are the only ones on the European market with type testing verified by a notified body (notified laboratory), confirmed by Certificate No. E-30-00316-06 Brno 2006-05-12. The products have been tested for about a year at a potential customer’s facility and for 3 years in some pumping facilities made by EkoWodrol. So

far, all the tests, also carried out at demanding customers', have given very positive results.
The opinion of Jerzy Koprowski, Director of Termo-Bis in Toruń, confirms this: "I came into contact with EKOWODROL at the WOD-KAN Fair in Bydgoszcz in 2006. I was very much interested in the construction of the non-return knee valves. The solution designed by the engineer Szuster eliminated the hazard connected with blocking the ball in a side pocket (construction of non-return simple ball valves), especially during start-up, when a simultaneous network rinsing is performed. Moreover, the location of the ball itself during the valve operation, i.e., when wastewater was flowing through the valve, suggested a laminar flow (low resistance). I decided to use the valves in the intermediate pumping stations we were producing. Thanks to this solution, the problems with blocking balls and noisy operation (the moment of closing in standard construction valves, particularly at great lifting heights) stopped. Furthermore, the valves constructed by Szuster allow for pressing pipe revision between the foot and the valve and from the valve through a gate valve to the tee. The position of the lid itself facilitates the valve opening without the risk of the ball falling down to the intermediate pumping station chamber. At the moment I am impatiently waiting for the implementation of a new compact construction (a non-return valve integrated with a knife gate valve). I am intent on constructing high utility class buildings and so I carefully select both the pumps and fittings and the construction solutions of internal systems. I heartily recommend using EKOWODROL non-return knee valves."

Exceptional possibilities – new applications

The new construction of the non-return knee valve has some exceptional characteristics:

- low flow resistance and lack of ball vibration during flow
- full opening of the valve immediately after switching on the pump
- possibility of cleaning the interior quickly.

Special attention should be paid to seemingly unimportant characteristics – a quick and full valve opening and the lack of ball vibration during the flow of wastewater with a high content of solid parts (hard and heavy and fibrous). The situation most often occurs when an intermediate pumping station is first started, after making a new sewage system part with new connections and after heavy rain, when there is more sand and stones in the sewage system. A similar situation can be observed in intermediate pumping stations with a preliminary separation of solid parts (called wastewater pressing stations), even during normal operation, since after switching on the pump, the greatest concentration of solid parts in the stream flowing in the separator outlet pipe occurs within the first few seconds of pumping. The advantage of the new valve in this case is definite and based on the principle that heavy solid parts flowing through the valve do not encounter a vibrating ball in the valve, which means they do not lose their speed in the area of a widened section of the flow. That is why the minimum safe flow speed in a vertical section of the pressing station pipe is e.g., 1.0 m/s and not, e.g., 2.0 m/s as in a standard non-return ball valve. If a wider flow section inside the valve body compared to the section of the outlet pipe section does not have a particular influence on slowing down the motion of a heavy solid particle carried in a stream of liquid, due to its inertia and a short section of the widened flow, a ball vibrating inside the body makes the particles bounce against it, in the direction opposite to the liquid motion. This, in turn, makes some stones vibrate together with the ball and after the pump is switched off, move with the ball to the valve socket, causing their mutual blocking on the inner, side wall of the valve body. In the case of fibrous parts present in wastewater, the situation is similar. It requires frequent intervention of the service in the first few days after start-up of the intermediate pumping station.

Thanks to its advantages, and particularly its reliability in almost all conditions, the new construction of the non-return valve is used in wastewater pressing stations on outlet pipes, directly behind the separator (HYDRO-VACUUM, KSB-BECKER), where standard non-return ball valves do not always work properly. Such a location of the valve allows for cleaning the separator by the easy and quick removal of the valve lid.
The possibility of using the valve at the intake side of the pump is another interesting valve characteristic. It was used in the construction of the inlet valve in the intermediate pumping station with a separation of solid parts (HYDRO_VACUUM) as a valve cutting off the gravitation flow to the separator when the pump is switched on. The speed at which the valve is closed after switching on the pump can be adjusted with the valve ball weight and can be between 0.2 m/s and 1.5 m/s (optimum: between 0.5 m/s and 1.0 m/s).

Unexpectedly it turned out that the same property of the valve can be used for regular pump venting by a lateral installation of a non-return knee valve, e.g., DN 32 in the outflow pipe, between the pump and the non-return valve or in the upper part of the pump spiral. The photo presents such a valve application – the intermediate pumping station system in a dry chamber has been operating reliably since 2007. The solution can also be used on an outflow pipe after the non-return valve as a vacuum breaking valve (it makes the creation of a siphon when the pressing pipe is positioned downwards). What is interesting, in the intermediate pumping station installed in a dry chamber, when the inflow is poor, an air-locking of the pump practically immobilises the station. Commonly used venting hoses connecting the upper part of the pump spiral with the retention tank clog and require frequent cleaning.

Summary

New and exceptional product characteristics often assist in solving other problems, not solved so far, such as automatic pump venting with simultaneous non-return valve flushing (see: Photo) after switching off the pump and its automatic closing after switching on the pump. The valve can be used in the same way on the wastewater pressing station by-pass, when the pump suppresses the flow from the wastewater pressing station separator to the retention tank. Once again let me refer to my favourite author, P.F. Drucker and his rule, or rather a warning that I heed when designing and implementing new solutions: "You should not be too clever. Innovations have to be realised by ordinary people, and if the innovations are supposed to reach a greater size or

importance, then by idiots or almost idiots. Incompetence is the only thing that there is plenty of and whose stock is endless. Anything that is too smart either in its design or realisation is bound to fail."

The above quoted statements are certainly intentionally exaggerated by P.F. Drucker to emphasise the weight of the problem. It is difficult to design something new which will meet the highest technical and functional requirements as well as be easy to operate and user proof.

With regard to the more technologically advanced equipment accessories used in water and wastewater management systems that have to fulfil the increasing requirements both as far as their technological and technical side is concerned, the reliability of individual elements of a system, device and finally of the entire system gains more and more importance. Only one element of the system can hamper a device operation, and as a result the entire system operation. Electronics has become more common but what never becomes common is the reliability of devices and their components, such as pumps on non-return fittings and their durability connected with resistance to user error and operating conditions.

Bibliography:

1. *Drucker, Peter F., Innovation and Entrepreneurship. Practice and principles, PWE, Warsaw 1992.*
2. *PN-EN 12050-4*

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