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Requirements and suitable solutions for water supply and water treatment plants

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ABSTRACT

The paper takes a closer analysis of a water supply system scheme from its beginning to end, mainly focusing on valves to be applied at each stage and how to implement them at the best. Each valve has specific features and, besides the correct installation for any required application, the economic convenience of coupling some specific valves with each specific plant is investigated.

Keywords: Water supply system chain; Water distribution systems; Valves; Water treatment plants

1. Introduction

Access to clean water for all is an essential part of the world we want to live in. People, companies and organizations involved in the water sector actively ensure the right management of a scarce resource.

The importance of a correct management of water is not only related to it as the primary resource in drinking, but also as a collateral resource for irrigation/agriculture and consequent population development, as well as a raw feedstock widely used in industry for manufacturing and product transformations.

Different levels of hydrogeological environment, urbanization and water availability would lead municipalities to different choices in terms of project design and installation. The optimal objective would be to realize an infrastructure able to intercept and distribute high quality water, preventing deficiencies in fragile territories, as well as integrating distribution in complex contexts.

In general terms, we would aim to an infrastructure that captures water, carries out a treatment, stores it and distributes it to the community in its total entity, with adequate pressure and acceptable quality, from the source of supply to consumers on a regular basis.

We will now encompass each phase of the water supply system and verify the most suitable valve to be applied at each stage and the advantages it has based on practical experience arisen in our client's projects.

2. Phase of water captation

The most common way to collect water is by surface water. Captation of surface water is done through intakes, in some cases filtering galleries are used, parallel or perpendicular to the water course to capture the resulting water with a preliminary filtering. Water dams managed with a double purpose are definitely a good practice, indeed. On one side, as standard, water collection; on the other side, business generation by the means of energy creation and/or fields irrigation.

Governments, Ministries and Municipalities take actions to invest in the water dam with additional purposes, for example by deciding to set up hydroelectric power plants in order to transform the hydraulic energy of a natural or artificial waterway into electricity. This option is very favorable in territories with a good hydrogeological environment, such as high availability of water basins or in high mountains.

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In the set-up of a hydropower plant, Howell Bunger valve is frequently applied. Also called hollowjet valve or fixed cone valve due to the inverted hollow cone core, it is an energy dissipating valve, in fact it dissipates enormous amounts of energy by breaking up discharge water into a large hollow jet. The inner parts are in stainless steel.

The fixed cone valve is used in turbine bypass in hydroelectric power stations, for continuous flow control discharge and for closing and regulating bottom and intermediate water outlets of dams and reservoirs. The fixed cone directly discharges water into the atmosphere at the end of the pipeline, dissipating the energy by spraying out a water jet, which is usually collected in pools or in the surroundings. Fixed cone valves can operate as regulating valves as well, due to intermediate linear opening positions.

The advantages of this valve are: simple construction design, no cavitation, no vibration problems, no load limitations, easy to operate.

2.1. Installation modes

A - Free discharge in the atmosphere at the end of the pipeline.

B - Submerged discharge through the downstream wall of the dam.

Especially in this second case, we suggest pipe and valve to be installed inside a load rupture chamber and to be protected with a larger pipe hood, to grant correct aeration around the valve because large volumes of air are coming out along with water (Figs. 1 and 2).

3. Phase of water treatment

Virtually all major systems must treat water, as globally regulated by the World Health Organization.

The treatment of water to make it drinkable is the most delicate part of the system. The type of treatment selected may vary and depends on the quality of raw water. Water purification usually occurs near delivery points to reduce the chances of water contamination after treatment.

In special cases, for example in case of seawater and brackish water, special treatments by membrane technologies of several kinds are used to purify water. Since modern membrane filtration techniques involve special equipment, the price of drinking water may increase consequently. On our side, we can participate cutting the costs of valves, with the installation of high level, compact and versatile valves (Figs. 3 and 4).

They are characterized by being quick to operate, in fact they work automatically, by the means of a spring, or even by the simple action of water flow. The wafer swing check valves have compact dimensions and reduced weight. They are easy to be installed, because the valve opens in case of any minimum pressure increase, and closes at any minimum pressure decrease. Completely made in stainless steel, with the seat inside the body of the valve, and an integrated gasket, wafer swing check valves can be installed between flanges PN 10-16 and ANSI #150, without any need of additional flange gaskets.

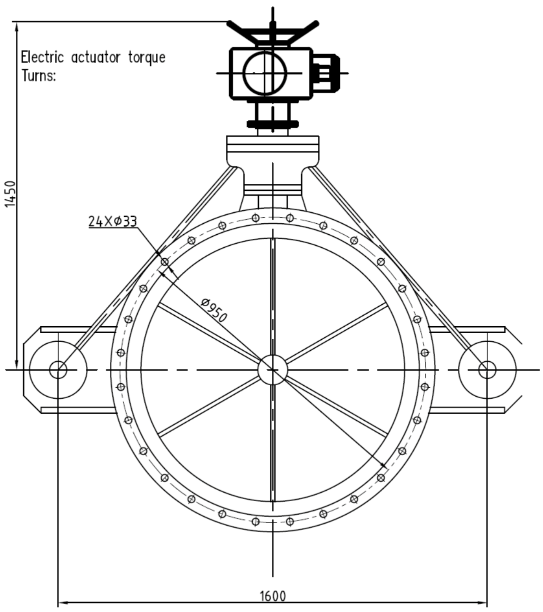

Fig. 1. Howell Bunger valve design.

Fig. 2. Howell Bunger valve by Valvotubi Ind.

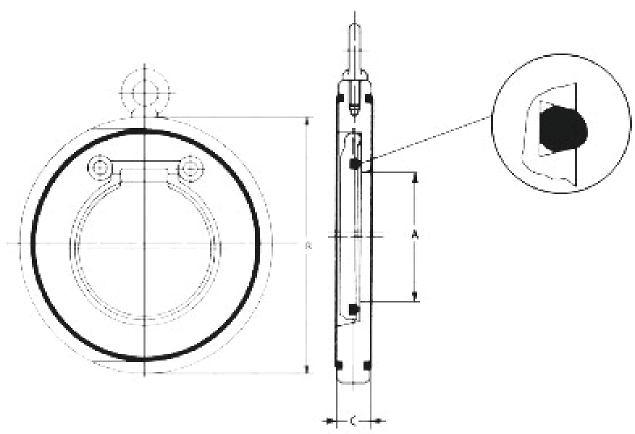

Fig. 3. Wafer check valve design.

Fig. 4. Wafer check valve by Valvotubi Ind.

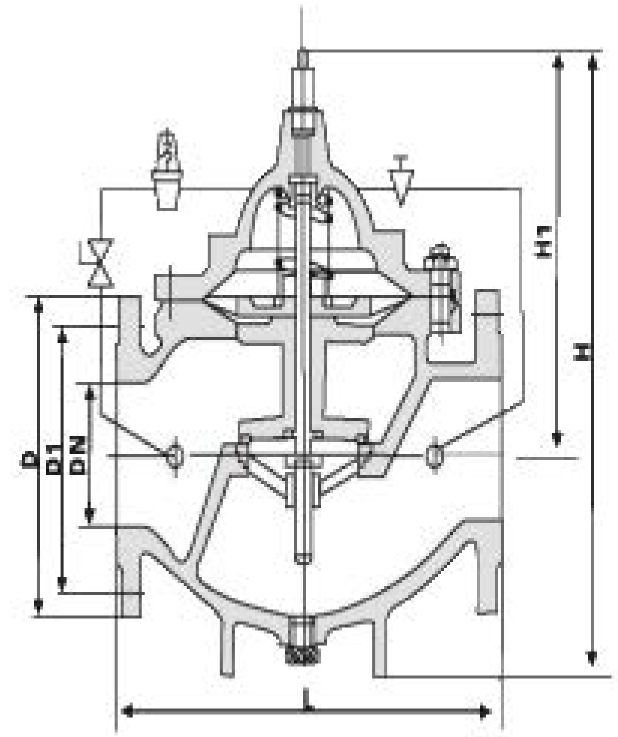

Fig. 5. Flow control valve design.

4. Phase of water storage

The storage of treated water has the function to compensate hourly variations of consumption, and to store strategic volumes of water for emergency situations, such as fires. The storage of raw water becomes necessary when the water source does not have a sufficient flow throughout the year to supply the amount of water needed. For example, rivers that do not guarantee the necessary flow at all times.

Generally speaking, water is stored in tanks. In this phase of the system, control valves are largely applied for multiple purposes, such as flow control, level control, pressure control and so on (Figs. 5 and 6).

Fig. 6. Flow control valve by Valvotubi Ind.

The flow control valve works with a very accurate pilot valve, suitable to manage both flow and pressure, to keep a preset flow value, to limit any excess of flow or upstream pressure, while downstream will not change, even if the pressure of main valve may change in downstream. This is just an example of control valve, but many kinds are available. For example, if the need is to keep a preset volume of water in the tank, float valves should be installed. They only open when the established level falls and they close progressively as the water level returns to its maximum position. They can work remotely, very useful with far or high tanks and reservoirs. Or, for example, municipalities may decide to reduce water pressure, to have water available for all the community, compromising it with a lower pressure rate. In this scenario, pressure reducers should be installed.

5. Phase of water distribution

Once treated, water is distributed through the local network.

The distribution line starts, generally, in the treated water tank, converting the water pressure by a pump, by the gravity supply of a water source (such as a reservoir or a water tower) at a higher elevation height, or, in smaller systems, by compressed air. At pumping stations, valves work continuously and their operation is frequently stressed by the thrust of pumps. For this reason, solutions have been implemented, such as the nozzle check valve, which is a non-return valve able to work continuously, and very fast, with immediate reaction to the stop of the pump (Figs. 7 and 8).

The valve grants a good performance in anti-hammer effect. The valve ensures a shock-free closing before any change in the flow direction and it can be installed in any position. This is a versatile product that receives appreciation for its good operation in several plants,

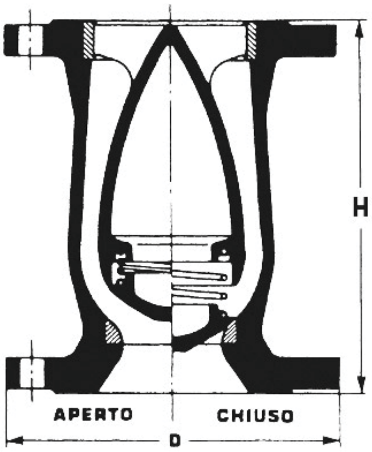

Fig. 7. Nozzle check valve design.

Fig. 8. Nozzle check valve by Valvotubi Ind.

including desalination plants and water treatment plants, not to mention water distribution plants.

6. Final review

It goes without saying that any plant involves multiple purposes and parameters, all these structures are connected or contained within other structures, creating an interrelated set of processes and procedures.

In general terms, the main evaluation is based on the environment of the specific area, on the numbers in terms of population served, on municipality needs to be satisfied. Then, working on the most appropriate plant design to satisfy the requirements, will also lead to a reduction of maintenance needs, if valves and other equipments are properly selected.