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Supplying of Drinkable Water

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Abstract- The problem of drinking water is that it does not have a permanent solution, so you need always to look for new forms and sources of supply, conducting hydrological studies geohydrological or to use it to benefit the people.
From the Industrial Revolution to the present, automation has been the best tool to make an indispensable work going on to compete in the global market tool. In these times, no company can omit the automation of its industrial processes to enhance product quality, increase production, reduce production time, minimize the risk of damage or disaster, perform complex tasks, reduce waste and bad parts mainly manufactured and increase profitability.

I. INTRODUCTION

Water covers three-quarters of the surface of the Earth, however, the scarcity of fresh water is considered one of the most critical global problems to be solved. According to the United Nations, more than one-fifth of the world population (1.2 billion people) live in areas with water shortages and nearly a quarter of the world's population (1.6 billion people) faces water shortages in a not adequate infrastructure to draw water from other sources. Even countries that do not suffer from water scarcity at this time may experience water shortages soon due to population growth (and increased water demand) due to climate change and global, such as the drought. Therefore, we must find new ways to get additional freshwater sources and to seek new solutions; it is of vital importance to be considered today by all countries.

The supply drinking water systems are part of the urban infrastructure. These systems should ensure the continuity of water supply, water quality control, monitoring and control of the technological process, and deal with the constraints imposed by the availability of water, hydrological conditions, the storage capacity of the tanks, water towers, and the growing diversity of water use. The system includes pumping stations, filtration, chemical treatment utilities, storage tanks and towers, piping, distribution network, and central SCADA system. This SCADA includes a center connected to the main structure, which communicates over PLC implemented at the pumping stations or RTU located in control panels along the network.

Currently, it provides automation solutions in industrial processes, achieving better production, saving time and personnel. In these times of water scarcity product of climate change and pollution, it seeks to purify any water for example. Wells, lakes, ponds, polluted rivers, etc.

II. MATHEMATICAL MODEL

Bernoulli's principle also called Bernoulli equation, or Bernoulli Trinomio, describes the behavior of a fluid moving along a streamline. It was presented by Daniel Bernoulli in his book Hydrodynamics (1738) and expresses that in an ideal fluid (without viscosity or friction) in circulation regime by a closed conduit, the energy possessed by the fluid remains constant along its route. The fluid energy at any time has three components:

1. Kinetics: it is the energy due to the speed that holds the liquid.
2. Gravitational potential: energy is due to the altitude that a fluid possesses.
3. Energy flow: energy is a fluid containing pressure because it has.

The following equation called "Bernoulli equation" (Trinomio Bernoulli) consists of these terms.

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$$\frac{V^2\rho}{2} + P + \rho\, g\, h = constante$$

III. BERNOULLI EQUATION

They use the Bernoulli equation to analyze the behavior of pressure and to determine the appropriate pressure to the system since the height and pressure are related inversely proportional manner, with data and measurements obtained through the barometer, took two pressure readings, the separation of the first and the second point is 3.02 meters.

Then we proceed to replace the measurements obtained in the equation of Bernoulli's principle:

$$\frac{V^2\rho}{2} + P + \rho\, g\, h = constante$$

Where:

V = fluid velocity in the section considered.

ρ = fluid density.

P = pressure along the streamline.

g = gravitational acceleration

h = height in the direction of gravity from a benchmark

Units of measurement of variables:

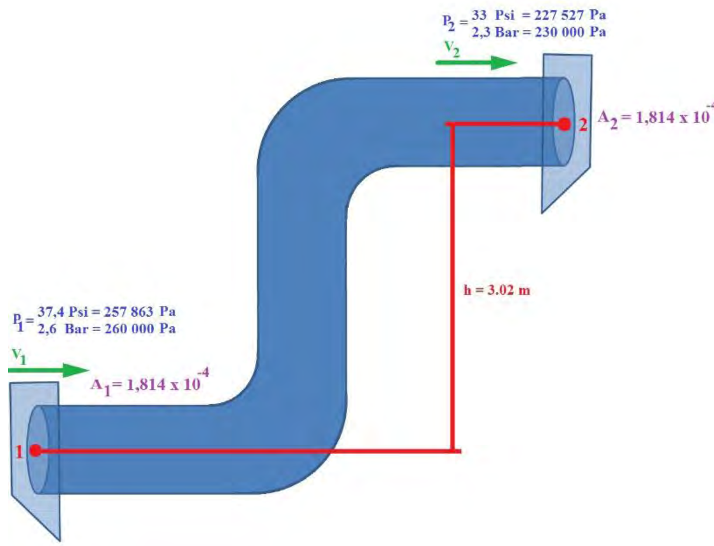
V = m⁄s ρ = 1000 P = Pascal

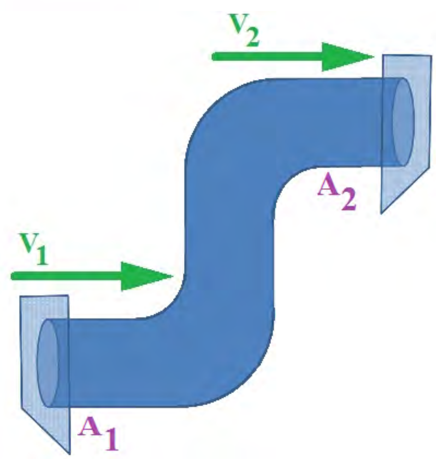
g = 9,81 m^2⁄s h = metros

System Simulation

So we get two constants will match it by:

$$\frac{V_1^2\rho}{2} + P_1 + \rho\, g\, h_1 = \frac{V_2^2\rho}{2} + P_2 + \rho\, g\, h_2$$





$$A_1\ x\ V_1 = A_2\ x\ V_2$$

Equal areas:

$$A_1 = A_2$$

$$A\ x\ V_1 = A\ x\ V_2$$

$$V_1 = V_2$$

$$\frac{V\,\rho}{2} + P_1 + \rho\, g\, h_1 = \frac{V\,\rho}{2} + P_2 + \rho\, g\, h_2$$

$$\frac{V\,\rho}{2}$$

$$P_1 + \rho\ g\ h_1 = P_2 + \rho\ g\ h_2$$

$$1\ (Bar) = 100\ 000\ pascales$$
$$P_1\ = 2{,}6\ Bar\ = 260\ 000$$
$$P_2\ = 2{,}3\ Bar\ = 230\ 000$$

$$P_1 + \rho\ g\ h_1 = P_2 + \rho\ g\ h_2$$

$$h_1 = 0 \qquad\qquad h_2 = 3{,}02\ m$$

$$P_1 = P_2 + \rho\ g\ h_2$$

$$P_1 - P_2 = \rho\ g\ h_2$$

We get:

Real mathematical data = data obtained

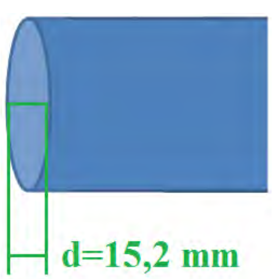
$$P_1 - P_2 = \rho\ g\ h_2$$

$$260\ 000 - 230\ 000 = 1000\ x\ 9.81\ x\ 3.02$$

$$30\ 000\ Pa = 29\ 626.2\ Pa$$

Result = 373.8 *Pa* represents us a margin of error between the actual data obtained dare barometer and mathematical calculations, this shows that Bernoulli's principle can demonstrate and is present in daily life and that the margin of error resulting from the system in which we worked is not an ideal medium.

Flow (Q): We will use flow rate for the liquid exiting point 1 per second this will help us to determine the time of filling of the reservoir where the water will be stored, the time variable is critical for the plc programming.



$$Q_1 = A_1\ x\ V_1$$

$$V_1 = \frac{Q_1}{A_1}$$

finding: A_1

$$A_1 = \pi\ .\ R^2$$

$$A_1 = \pi\ .\ 7.6^2$$

$$A_1 = 1{,}814\ x\ 10^{-4}\ m^2$$

The flow rate is found by obtaining the sample few liters per second goes by point 1

$$Q_1 = 0{,}5\ Lt/s$$

$$Q_1 = 0{,}0005\ m^3/s$$

$$V_1 = \frac{0{,}0005\ m^3/s}{1{,}814\ x\ 10^{-4} m^2}$$
$$V_1 = 2{,}76\ m/s$$

Now the speed obtained and we can determine the filling time of any container.

IV. PRESSURES

To determine the variables of pressure and work in the range of the water pressure, the system automation must decide the minimum pressure. This minimum pressure is thepressure measured at different points of Lima as El Agustino, SJL, Mariscal Caceres, Carabayllo; at rush hour when consumption is highest. With these results a constant pressure for distribicion be ensured:

.PISOS	1ER	2DO	3RO	4TO
El agustino	31 psi			
SJL 1	62 psi			
SJL 2	30 psi	23 psi	22 psi	17 psi
Carabayllo	38 psi	33 psi		
2 AM	41 psi			

V. REVIEW AND EVALUATE THE WATER PURIFICATION SYSTEM

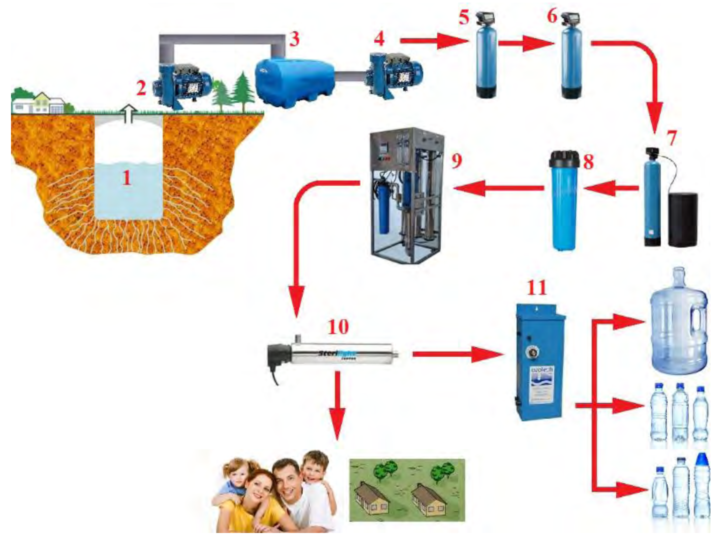
The process of purifying drinking water consisting of a series of steps to which the water is subjected to kill microorganisms, waste, and garbage that can exist in water. To obtain higher purity water quality and consumable, this system purification of water from rivers, lakes, rainwater, wells, urban network, pipes, springs, containing compounds that are harmful to humans. There are some processes to be carried out to ensure that water is safe to drink, not just enough to boil, it just kills microorganisms and bacteria, but the water may contain arsenic, metals or other contaminants.

In the automation system seven purification procedures were used:

1) Sand filter.
2) Carbon filter.
3) Smoothing filter.
4) Polishing filter.
5) Reverse osmosis.
6) UV lamp.
7) Ozone sterilization

V. DEVELOPMENT PROJECT

In the following figure. The process by which tell the automation system is shown.



Then the process of FIG be described:

1. The well has a depth of 40 meters and the amount of water to be had is 4 m^3 constants with this water flow enough to power the system.
2. The engine 2 is of the brand Siemens HP 1-20, 1.15 service factor, 40 ° C ambient temperature, 3600, 1800, 1200, 900 RPM Three-phase, 60Hz, 208-230 / 460V operation.
   A pressure sensor Brand EBC with a current output of 4-20 mA.
   A variable frequency Brand ABB ACS550 Model
3. In Section 3 the reservoir where the water from the well capacity is 1000 m ^ 3 is deposited is The motor item 5 is Siemens of 1-20 HP, 1.15 service factor, 40 ° C ambient temperature, 3600, 1800, 1200, 900 RPM Three-phase, 60Hz, 208-230 / 460V operation A pressure sensor Brand EBC with a current output of 4-20 mA.
   A variable frequency Brand ABB ACS550 Model.
4. At this point begins the purification system through the sand filter that removes all large debris that may exist in the water is branded as leaves, stone, earth, sticks, etc. The filter is of the GreensandPlus brand.

6. Section 6 is the carbon filter will remove the smell, color and taste of the water and that water should be colorless and tasteless.
7. Point 7 is the smoothing filter should be required that water has a hardness level. This situation means that the calcium and magnesium hardness that produce will be removed almost completely from the water to be treated.

8. In Section 8 the polishing filter containing a multi retention filter will allow retaining particles suspended in water using a 5-micron filter and prevents mainly in continuing the process of purification and multi retention. It gives crystallinity to the water to make it look cleaner.
9. In Section 9 is the reverse osmosis will retain all minerals in the water that is necessary when the water has excess minerals
10. In point 10 is ultraviolet lamp is an excellent germicidal because it avoids passing around any bacteria suspended in the water.
11. In point 11 is sterilization by ozone dare a Venturi valve cam ozone is injected into the water to give the expiry water allowing the water does not become greener prolonging the life of stored water as bottles, jugs, etc.

VI. WATER SUPPLY NETWORK STRUCTURE

Data from the RTU mounted remote center to avoid any failure of the PLC pumping stations and water reservoirs are transmitted to the dispatch unit. SE SCADA system developed specifically to control the water pressure.

The SCADA system dispatch unit draws diagrams, charts and reports related to the operator the exact system data such as pressure and water level and level of chlorine. The system stores the data in a particular database for later use and recovery analysis.

VII. AUTOMATION SYSTEM PUMPING STATION

Technological equipment installed in pumping stations are controlled by a PLC based computer that acquires all the hydraulic parameters (pressure, flow, water level, temperature, free and residual chlorine, pH) and electrical parameters for all drives electrical (current, voltage, active/reactive power, power factor, frequency).

The pumping operation module implemented in the PLC includes a programming optimization tool based on the following criteria:

- The rates of electricity per hour,
- The water demand dynamics and limitations.
- Statistical records regarding water demand,
- Maintenance planning related to market demand.

The optimization module facilitates the passage to preventive or predictive exploitation of water resources and storage capacities based on intelligent control algorithms. They represent the support for optimizing the cost of electricity for a real-time monitoring program and the pump on/off a transient load electric drive, maintenance planning based on the functional load and wear.

The main modules of the software application implemented in the pump station PLC equipment are:

- Digital and analog signal processing block,
- Setting value limits and validation,
- Acquisition and treatment of electrical parameters,
    - Data storage and retrieval module,
    - Management Module data communication,
    - System Controller,
    - sequences and pump and valve control algorithms,

- process control algorithm based on the level or pressure reservoirs of water set point according to the demand distribution,
- Self-monitoring and diagnostic module technological processes.
- Operator Console - HMI – operator, fully integrated custom operating procedures.

VII. CONCLUSIONS

- The automated system implemented in the distribution network of drinking water ensures the upgrade urban water supply reformed public services. It is offering new forms of surveillance and optimal exploitation of water resources and technology and equipment. The SCADA computer system for its vast geographic area distributed intelligent components allows:
- The overall monitoring and remote control of all network hardware and water management water flow according to user demand available. The volume of water related to the level of the reservoirs and capabilities, including correction determined by the pressure at key points in the network.
- Reliability of the measurement data given by the system.
- Continuity of water distribution and the protection of water quality; decrease loss of water resources; water leak detection control by the consumer or the pressure drop online
- The alarm information in real-time operator caused by any failure of equipment in the distribution system, optimization of operating and maintenance costs.
- Development of automated data bases as the first step for future system-specific data driven decision support.

REFERENCES

[1] G. Badea, "Sanitäre INSTALATII", Editura RISOPRINT, Cluj Napoca, 2005,
[2] G. Badea, "INSTALATII de alimentare cu apa, canalizare, Sanitäre si de mirar ", Litografia Universitatii Tehnice, Cluj Napoca, 1982,
[3] Manual Westermo 5.0, "Comunicación de Datos Industriales; Industrial Ethernet ", 2007,
[4] Siemens AG, "Automation and Drives Comunicación de datos inalámbrica basado en GPRS ",
[5] Algodue Elletronica, "UPM 304 Manuales", Italia, 2007,
[6] Siemens AG, "arrancadores suaves SIRIUS 3 RW 44 Manual", 2007,
[7] ProMinent Group, "Proceso general de abastecimiento de agua", 2007