In order to improve quality of drinking water, ZWiK Sp. z o.o. - Waterworks - in Szczecin have realized some backfittings and built new filter plant placed on active carbon deposit in ‘Miedwie’ Water Production Plant – the biggest object of such type owned by ZWiK Waterworks and at the same time primary water source for Szczecin. Newly-established filter plant was equipped with modern automatic system, in which the key role performs Wonderware Application Server working as SCADA system based on the Archestra architecture.

The whole water acquisition and treatment process consists of several stages:
1. Bailing and pumping water from Miedwie lake (pumping station P1);
2. Preoxidation - ozonization;
3. Coagulation and sedimentation;
4. Accelerated filtration – anthracite-sand deposit;
5. Intermediate oxidation;
6. Adsorption in carbon filters;
7. Disinfection with chlorine dioxide.

Backfittings of existing object
Air filters were the first modified element of the whole process of Miedwie lake surface-water treatment in ‘Miedwie’ Water Production Plant, owned by ZWiK Sp. z o.o. - Waterworks - in Szczecin. Water is filtered through 12 opened accelerated filters, 36m² of surface each, of maximum combined capacity 100.000 m³/twenty-four hours. Filters were put to use in 1976, and since then have worked continuously until backfitting in 2001, being only currently maintained and fixed.

Backfitting and general overhaul were necessary due to worsening technical condition. The aim was to radically improve technical condition and to modernize filters maintenance, using monitoring and automation.

Consequently the aims achieved were: improvement of filtered water quality, and savings coming from rinsing process automation and using two-layer anthracite-sand deposit (shorter rinsing time with smaller amount of water used). Filters maintenance system modernization consisted in introducing monitoring and automation elements allowing remote controlling of filters functioning. Installation was designed to work in fully automatic mode, implemented through GE Fanuc programmable controllers and Wonderware SCADA system. Servicing personnel duties reduce to filters rinsing time acceptance, inspection of filtering and
rinsing, parameters controlling, and devices conservation. Filters operation visualization was accomplished with Wonderware InTouch HMI (Human Machine Interface). Next stage of ‘Miedwie’ Water Production Plant modernization, in which automation had meaningful role, was backfitting of 15 kV electrical power system, accomplished in 2005.

The whole electrical power system is controlled by GE Fanuc 90-30 PLC controller. Communication between PLC and actuators is implemented through Modbus communication protocol.

Updated computer system consists of three operator stations using: InTouch HMI visualization software, ActiveFactory software tools package (for data reporting and analyzing), and Wonderware Historian (formerly known as IndustrialSQL Server or InSQL) database (which allows acquisition and convenient managing of process information and economic data simultaneously from all applications).

15 kV switching station remote controlling is completed according to specially prepared procedures for every turn on, turn off and switching operation. Moreover monitoring encloses every necessary parameter in 15 kV and 0.4 kV electrical power installation, such as: real power consumption, reactive power consumption, temporary power consumption, currents and voltages measurement for every supply and phase, energy measurements, frequency measurements, and so on. Every parameter measured in measurement field is recorded in database. Parameters are used for analyzing loads from particular supplies, transformers, temporary power consumption, especially in the context of power ordering. All three operator stations are linked with Ethernet network.

Carbon filters

In the year 2004 within the framework of ‘Water quality improvement in Szczecin’ programme, company made a decision about building new filter plant placed on active carbon deposit in ‘Miedwie’ Water Production Plant.

Carbon filters processing line includes following water treatment stages:
• initial filtered water supply installation and indirect pumping station;
• final stage of ozonization in two final oxidation chambers (2 lines);
• absorption in filters with granular active carbon;
• transfer into tanks with refined water.

Water treatment process proceeds gravitationally from existing anthracite-sand filters to indirect pumping station.

Indirect pumping station

Pumping station encloses three pumps (two working and one redundant) and one pumping pipe to contact ozonization containers.

Pumps are equipped with electric motors of changeable speed to allow working at different flow rates according to pre-filtered water inflow. Pumps electric motors speed adjustment allows indirect pumping station tank level controlling, which total capacity is 1.350m² (retention time 15 minutes at 5.400m³/h).

Pumps were designed for nominal capacity 2.700m³/h at 11 m lift height to provide capacity 5.400m³/h at the lowest level. Horizontal type pumps with shaft clutch adjusted to ‘dry’ electric motor installation were applied. Electric motors will be controlled with velocity change system in order to readjust flow rate in the range from 2.000 to 5.400m³/h.

Final stage of ozonization

Main ozonization stage performs following functions:
• Disinfection, particularly viruses elimination;
• Oxidation of remaining organic matter;
• Presumable pesticides reduction.

Ozonization is implemented by two ozonization lines. Every line is equipped with contact chamber with two ozonization compartments. First compartment’s task is ozone saturation at needed level; second one provides
contact time sufficient to viruses and bacteria elimination and to microfoulants oxidation.

**Filters with granular active carbon (GWA)**

The last stage of water treatment process in Miedwie Water Production Plant is granular active carbon filters complex.

Absorption on active carbon provides:
- Pesticides reduction;
- Organic matter reduction;
- Flavour, scent and microfoulants elimination.

GWA water treatment stage consists of filters battery containing 8 DEGREMONT CARBAZUR GH chambers. Chambers work gravitationally and their filtering medium is granulated active carbon.

Every filter’s elementary surface equals to 67.92m², which corresponds to filtration intensity at 7.66m/h. Filtered water stream is evenly distributed at the intake of filters battery to provide the same amount of water for every filter. Granulated active carbon deposit depth is 2.6m, which corresponds to deposit load at approximately 3 volumes of water per 1 volume of carbon per 1 hour, that is 20 minutes contact time at designed flow rate at 4.167m³/h.

**Automation and SCADA system**

Automation system is based on local PLC controllers with operator’s panel, each operating single filter; all PLCs are connected to main Siemens S7 414-2 PLC controller, managing elements common for all filters and operation of intermediate pumps, air-blowers, rinsing water pumps, disinfection pumps and 0.4 kV switching station.

Ozonization system used in carbon filters technological process is equipped with it’s own S7 313 PLCs supervising ozonization process, also connected to main controller. Individual filters, devices common for all filters, pumps, air-blowers and ozonization can be controlled locally from operator’s panels installed in individual controllers. In practice this process is automatic. Wonderware Application Server performs a key-function in this scope, being used as SCADA system based on Wonderware Archestra architecture.

SCADA is equipped with 4 levels of access and security. Its tasks are:
- Continuous process controlling and monitoring;
- System parameters modification;
- Existing and historical alarms supervision;
- Reporting;
- Monitoring of individual devices present in process.

System is based on two redundant operator’s stations with Wonderware Application Server software. Every station is equipped with InTouch visualization software, which enables working on two stations simultaneously. Wonderware Application Server industrial application objects and communication with main system PLC controller are performed in only one station, in case of its failure logic applications execution and communication with PLC controller are switched into second station, providing continuity of working with the system.

Communication with main PLC controller is performed by SIDirect communication server, main controller maintains remaining subordinate PLC controllers in the system.

Filter station visualization consists of 21 main screens displaying picture of entire technology, alarms screen, settings screen and so on; InTouch globally contains 280 windows (screens, pop-up windows).

One of the stations runs Wonderware Historian industrial database with access through ActiveFactory software analyzing-reporting software pack, opened for both operator’s stations.

Redundancy function accessible in Wonderware Application Server provides high reliability of the system.

**Archestra vs other visualization systems**

What is the supremacy of Archestra technology over other available on the market visualization system solutions?

Beneath there are a couple of features noticed by Mercomp Szczecin Sp. z o.o., which have accelerated and facilitated working with the application and further maintenance:
- Application development time shortening. This feature was achieved thanks to object programming consisting, similarly to classic OOP programming, in creating an object template and then unlimited number of it’s instances. For example 42 valves of the same type were used in active carbon deposit filter station. Standard SCADA type application would involve programming every valve separately. Archestra technology allows to create and programme object ‘VALVE’, and then to
create 42 instances ‘collecting’ features from the object. If during operation programmer would like to make some changes in all valves created from object called ‘VALVE’, it will be sufficient to alter only the object itself, and all the changes will be automatically updated in all 42 instances;

• Intuitive configuration of production structure. Using ‘areas’ enables developing tree structure of installation inside the application. Entire carbon filters installation was divided into 5 areas:
  - intermediate tank;
  - ozonization chamber;
  - filters;
  - refined water tank;
  - supportive devices.

Suitable object instances were placed in every area (valves, pumps, measurements, signalling devices). Programmer can easily find adequate instance (valve for example), knowing where it is placed physically.

• Popular script language. Easy and advanced at the same time language, using Visual Basic functions. Programmer doesn’t have to learn a new language, using known and widely applied language of Microsoft production;

• Simplicity of databases configuration. Wonderware Historian configuration takes a couple of minutes;

• Redundancy. Visualization system was installed on two industrial computers. One of them works as a server and client (main computer), the other was scheduled to work as a client (redundant computer). Such structure provides possibility of taking over the duties by redundant computer in case of main computer failure.

General contractor of this investment was a consortium of DEGREMONT and ENERGOPOL, automation system was developed by MERCOMP Szczecin Sp z o.o. Principal author of visualization system is engineer Marcin Galek. Filter construction works were finished in December 2006. At present technological start-up goes on, the end of start-up is scheduled on June 2007. Wonderware Application Server software licences were provided by ASTOR Sp. z o.o.

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