WASTEWATER TREATMENTS WITH SCADA APPLICATION

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Abstract

Based on the EU directives, Turkish government approved mandatory regulations for wastewater treatment. I would like to talk about about the current conditions in our country realationship between wastewater and population, and possible solutions for the wastewater treatment facilities in Turkey. I will present a model wastewater treatment facility for a town with 50.000 population and discuss the information management, control collaboration, motor control, energy monitoring, instrument control around SCADA applications of this model facility.

1. Regulations About Wastewater Treatments

In the process of EU membership, the "water frame directive" is the most important concerning water management. This directive passed in October 2000. Its goal is to protect and control the water resources in EU not only quantitatively, but also qualitatively.
Main goal is to make changes to our national legislations so that they are in compliance with EU environmental regulations. We also need to make sure these regulations are applicable, practicle and manageable. "[1]"

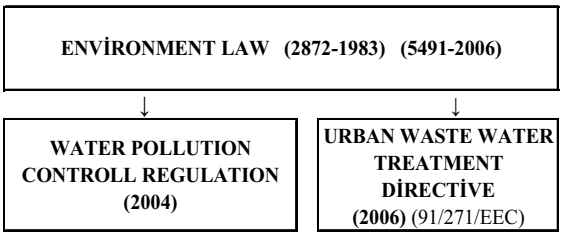

Fig. 1. National Legislation about wastewater "[2]"

1.1.Infrastructure of wastewater facility in Turkey:

Recent survey of 3225 municipalities by the Turkish Institute of Statistics in 2006 noted that 2321 (72%) had established sewage systems.

In that same year 49 percent of the 3.37 billion m^3 of wastewater drained through these systems was discharged into rivers, 45.2 percent to sea, 3.6 percent to dams, 1.4 percent to lakes and ponds, 3.6 percent to fields and 4.3 percent to other environments this total discharged amount, 2.14 billion m^3 (63%) was treated in the treatment plants**.** "[3]

Financing the investments to provide water on a long term basis at a reasonable price for the population.

The raw material needed to produce drinking water may come from different sources (springs, aquifers, rivers, oceans), and appropriate technologies have to be used.

The available space and the volume of water to be treated also determine the technical choices. In all cases, the required water quality has to be reached and proved in accordance with regulations and the authorities' contracts.

Some municipalities do not have proper water and wastewater treatment systems. Some of the smaller towns, due to their limited financial capability, may not be able to undertake large projects with international players, but there are still cities with 250,000 + populations without a treatment facility.

As far as the treatment of industrial wastewater is concerned, a small portion of industry fully complies with the rules and regulations on treatment of the wastewater generated at their own facilities. Some product groups which have potential in the Turkish market are: "[6]"

- Water pumps/filters/pollution control equipment (Turkey has a strong pumps and valves manufacturing base; high-end products could have a better chance in the market),
- SCADA systems,
- Design and operation of water/wastewater plants,
- Sludge treatment technologies,
- Leakage detection systems,
- Reverse osmosis, Membrane technology,
- Industrial wastewater remediation systems, and metering devices

The techniques used and the size of the treatment plant are inter-related and depend on:

- The input flowrate, which in turn depends on the population and any seasonal
- variations
- The type of pollution: domestic, industrial and/or agricultural
- Whether rain water is included in the input or drained by a separate systemEnvironmental constraints related to disposal: effluent discharge criteria, sludge re-use, odour control

Table 2. Current Situation (The numbers of settlement ratio of sewage system connection number of treatment plant and ratio of populations which benefits from the treatment plant services given below. "[3]"

Population Groups	Number of Settlements	Ratio of Sewage Systems (%)	Number of Treatment Plants (Secondary+Advanced)	Ratio of Population Served by Treatment Plant Services (%)
‹ 2.000	35.106	59	1	5
2.000 - 9.999	2.572	55	33	5
10.000 - 49.999	458	81	43	19
50.000 - 100.000	83	90	15	20
› 100.000	114	96	46	69
Turkish Statistcal İnstitute (2 004)				

Regulations are raising the water quality level requirement.

2. The Solution Model For 10.000-100.000 Inhabitans

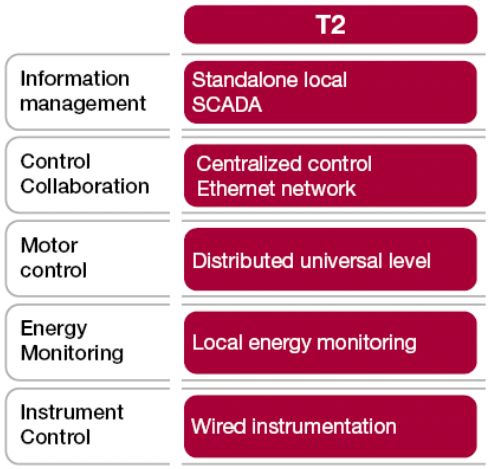

Fig. 2. Solution Model T2, "[4]"
(Inhabitance: 10.000-100.000)

Inhabitants	10,000 – 100,000
m3/day (drinking water or waste water)	5,000 – 50,000
Motors	50
Power demand	125 – 1250 kVA
Instruments	100

Fig. 3. Solution Model T2 Parameters, "[4]"

The quantity of information that must be analysed, processed and acted upon increases constantly and the use of multifunction PLCs capable of acquiring and processing data, system regulation and communication corresponds well to the needs of water-treatment plants. "[4]"

Sludge treatment, air treatment and biological treatment are examples of units that need to be added or improved in many wastewater treatment plants.

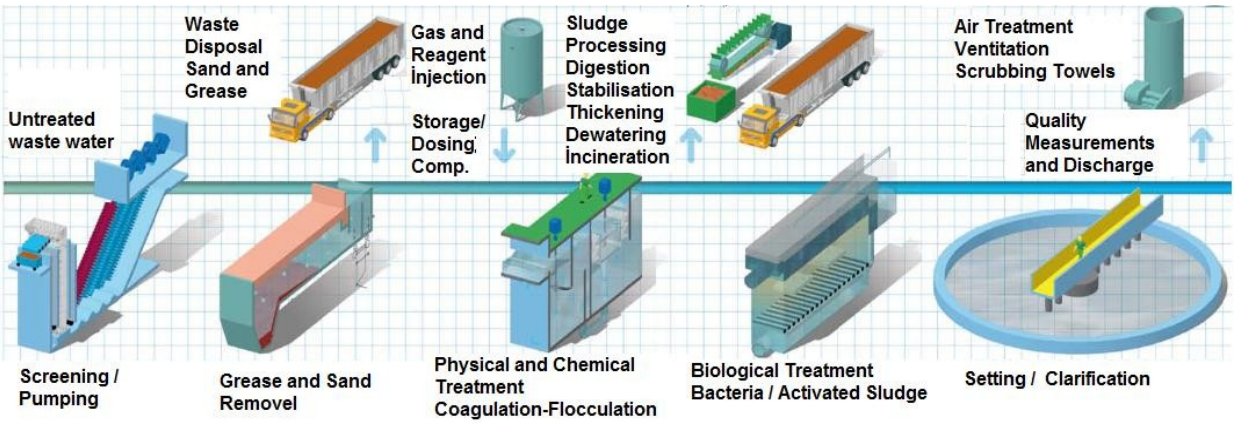

Fig. 4. Waste Water Treatment Process [4]

Compact Terminals - Display units with 1 to 10 lines
Compact Terminals - Extra video display & record from the t

Instrumentation:
UPS, Power Conditioning and distribution
Motors, Couplings, Gear Reduction Drives, Back Up Power Generators
Pressure, temperature, flow, and level transmitters
Liquid/gas analyzers, Valves and valves actuators

3. SCADA SYSTEM

SCADA (Supervisory Control And Data Acquisition) systems are crucial elements of many *water distribution and wastewater collection* systems, allowing centralized personnel to perform remote monitoring and control of widely dispersed equipment, generally pumping stations. Although the most common configurations use radio as the means of communicating with **RTUs (Remote Terminal Units),** other communication schemes are possible. These include direct lines, leased telephone lines and dial-up telephone lines. "[5]"

According to **T2** Model (in Fig. 3. and Fig. 4.) the system will be told below:

The plant produces daily **25.000 cubic meter fresh water for 50.000 citizens.**
Plant consists of raw water pumps, coagulation/flocculation drives, backwash, and many other motor loads aerators, mixers, and blowers, sludge and lift pumps, membrane filters.

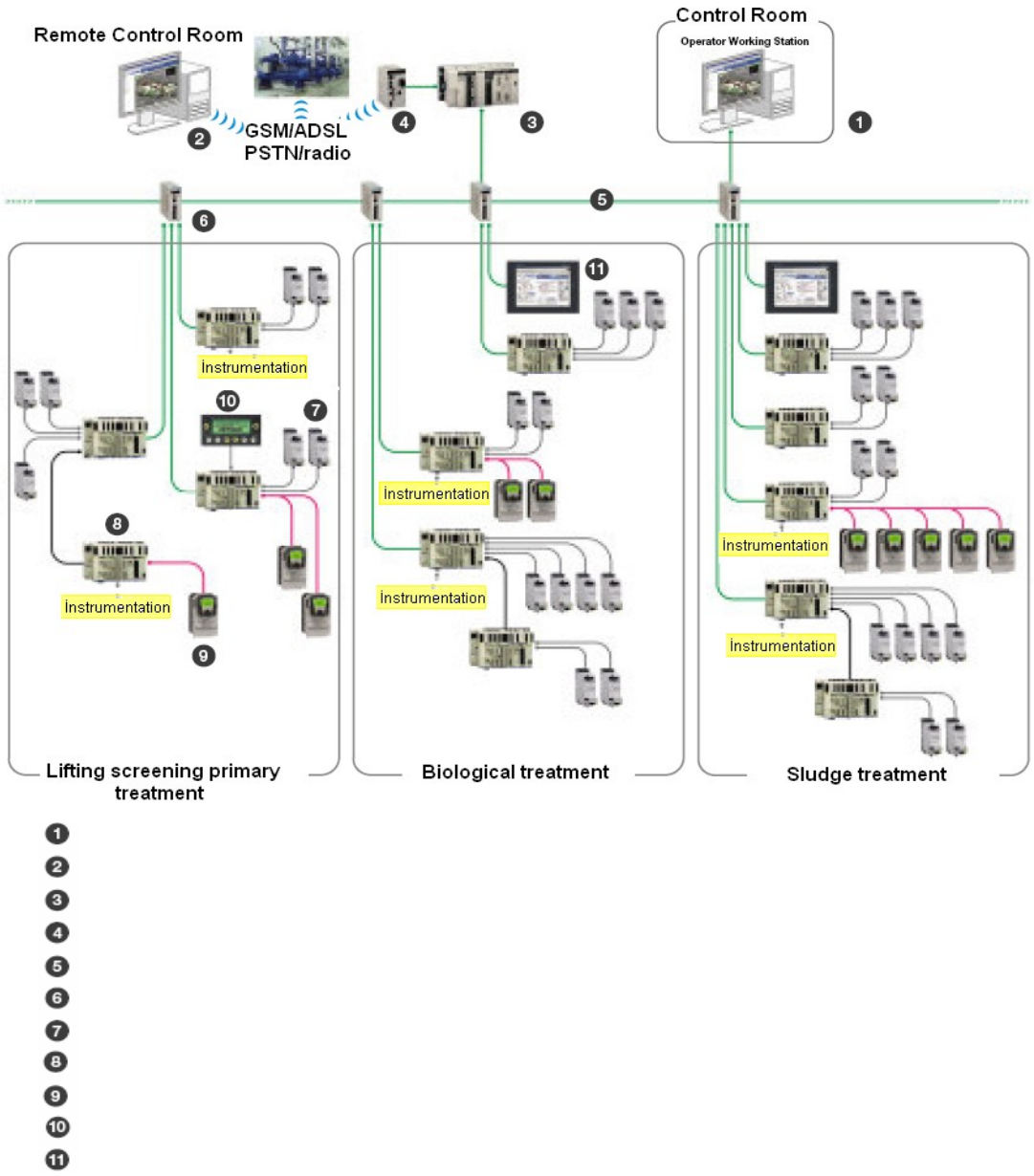

Fig. 5: SCADA System Of Waste Water Treatment "[4]"

The Process control system is designed to have all the characteristics of a complex continuous process and often require tight closed-loop control to produce high quality effluent. The Modicon Premium PLC family of Schneider for this project.

The treatment plant can be divided into following functionality, which can be controlled with a PLC (in Fig. 4. and Fig. 5.)

- Control room equipment (mosaic mimic with indicators)
- Lifting Screening Primary Treatment
- Biological Treatment
- Sludge Treatment

The technical requirements for the plant is quite high. All the plant relevant data should be collected on the ***redundant servers***. As redundant SCADA software, ***Vijeo Citect*** has been used. The redundant Vijeo Citect Servers were networked over ***TCP/IP***. The reporting of quality parameters can be made with MS Access. The interfacing of Access to ***Vijeo Citect*** is over ***ODBC (***Open Database Connectivity).

The plant manager and the operator can see the quality parameters like turbidity, pH, temperatur, pressure, flow and level transmitters,conditions of drivers, blowers and pumps etc. as well as their historical trend. These parameters can be send over an **Fiberoptic Ethernet Ring** (Ethernet Network, see Fig. 5.) to the SCADA center of company.

A standalone **Vijeo Citect** monitoring system provides an economical solution for a **T2 water solution** with only a few hundred points.

İnformation Management: It allows to Report (water quality...), alarm, trend, I/0 servers are centralized in one PC and develop easy to use water application graphics (sedimentation tanks, fi lter, clarifi ers,...) that provide the operator with an intuitive user interface.

Vijeo Citect system comprises objects from simple pushbuttons through to pumps and valves to complex loop controllers (water quality regulation).

Local control of the water process is achieved with compact **Magelis XBT RT** or graphic **Magelis XBT GT** (Compact Terminals, see Fig. 5.) located in each functional unit.

Process Management: A Centralized PLC **Modicon Premium** (PLC, see Fig. 5.)controls all the functional units (sedimentation, flocculation, filtration, desynfecting) of a T2 water treatment plant. Modicon Premium offers unrivalled performance, reducing cycle times and providing integrated diagnostic data.

Motor Control Management: Up to 100 motors, pumps or valves have to be managed in a T2 water plant. **Advantys STB** (Parallel Interface Module, see Fig. 5.) distributed I/O solution is an open and modular I/O system. It allows you to design a cost effective distributed functional island with cabling optimization. "[4]"

4. Advantages of SCADA System

- Safe, cost-effective, and reliable control over plant processes.

- The system ensures continuous monitoring and control of plant operations such as:

Wastewater collection systems,
Water distribution systems,
Pump stations; sewer diversion,
Wet weather overflow protection,
Water irrigation systems,
Weather monitoring,

- Remote operations and pumps, and remote erminal units(RTUs).

- Energy savings through integrated, real-time process and equipment information and coordinated, enterprise-wide energy management programs.

- Track and control manpower costs through a centralized monitoring and control system that reduces the amount of time and energy that personnel must spend on auxiliary equipment operation and maintenance

- A reliable system that is expandable.

- Local control from each pump station.

- The ability to communicate from the plant to each lift station and back through leased phone lines or radio.

- The ability to communicate between lift stations.

- Authorized personnel can have secure remote access to the plant using a standard web browser on their PCs.

- Increased reliability of the system due to the redundant PLCs and the redundant SCADA computers.

- Each remote site will continue to control its local I/O, even if the lease line communication to that site is lost.

5. Referances

[1] URBAN WASTEWATER TREATMENT Directive 91/271/EEC, Informal Meeting of the EU Water Directors Lisbon, 2007 Wastewater Reuse Report
[2] Waste Water Management in Turkey, Veysel Arslan (Environment and Forest Ministry), Vision 2023: Science and Technology Strategies, TUBİTAK
[3] Turkey Statistics Enstitute
[4] Schneider Electric Water Solution Application Guide
[5] Automation of Waste Water Facilities
Water Environment Federation (WEF) Manual Of Practice No:21 Chapter 15 Instrumentation and Control
System Specifications
[6] Environmental news with market research reports with trends, forecasts & analysis environmental articles, case studies, reports, papers in the world of sustainable development, Excerpts from "Water and Wastewater Market in Turkey", U.S. Commercial Service, May 2009.