

Management of Effluents in Industries

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ABSTRACT

Water pollution has become a higher priority task to handle these days and the Industries are keeping major part on water pollution. The polluted water is commonly called as Effluent. So, the effluent management among industries is a vital process and that should contain the effluent Monitoring, Data Acquiring and control over the effluent. When talking about Effluent, the unnecessary water wastage is also considered as water pollution. Because of this type of pollution, the ground water level is decreased and which could lead to the water crisis in future. So, considering all these factors we created a system which can monitor, acquire data and store for future, and do control over the intake pure water of an industry as well as the outlet effluent. Our project limits the intake water and outlet effluent based on the size of industry and if any abnormal activities of the industry is observed to their corresponding limits, then this system will ensure the responsive control activities against them.

Keywords: Industrial Automation, SCADA, PLC and KepServer.

I. INTRODUCTION

Effluent Management system helps in monitoring the total ground water taken and total amount of effluent produced by the industry. This data for each instance is stored in server for remote access. In addition to that this system sets limitations for taking ground water and also for the effluent production. If there are any deviations made by the industry on limits, control actions can be provided in order to make the industries to intake and release effluents as per the limits.

What is an Effluent?

Effluent is defined by the United States Environmental Protection Agency as "wastewater - treated or untreated - that flows out of a treatment plant, sewer, or industrial outfall. Generally, refers to

wastes discharged into surface waters". The Compact Oxford English Dictionary defines effluent as "liquid waste or sewage discharged into a river or the sea".

Effluent in the artificial sense is in general considered to be water pollution, such as the outflow from a sewage treatment facility or the wastewater discharge from industrial facilities. An effluent sump pump, for instance, pumps waste from toilets installed below a main sewage line.

Primary Objective

- To monitor the inlet ground water and outlet effluent production of every industries.
- To acquire data and store them in a server for remote access.
- To control the industries ground water usage

and effluent production with some reasonable limits.

- To treat the effluent for the reuse of water and collect the treatment charges from the corresponding industries.

Our proposing method consists of a fully developed SCADA screen for the Management of the effluents in the industries. This screen is developed such that, it is interfaced with the programmable logic controller using the software named as KEP server. The values are collected and stored using trends and historical trends functions of the SCADA screen and the controls are made by the switching operation performed by the PLCs. For continuous monitoring of values from long distances, a methodology known as port forwarding is used to accumulate data's and use it for control purposes.

The earlier methodologies were just used to accumulate data over short distances, monitor them and perform controls based on the values accumulated. But our system provides a long-range process control from a single screen to a number of systems inter connected.

II. SOFTWARES & COMPONENTS USED

2.1. Wonderware InTouch V10.10 (SCADA)

The combination of telemetry and data acquisition is referred as SCADA (Supervisory Control and Data Acquisition system) [1]. Wonderware InTouch delivers truly transformational value. By improving real-time visibility into your processes, InTouch greatly improves operator effectiveness and increases control of your processes to simplify and enforce standardization and change management. InTouch includes numerous new visual enhancements to improve the ability to identify and address abnormal situations before they impact operations. The powerful tools in InTouch go beyond the simplistic graphics provided by other vendors and enable application builders to focus on creating valuable

content and to easily assemble effective HMI applications for simplicity, agility and performance.

Application of In-touch in Management of Effluents in Industries.

Effluent Management uses Wonderware In-touch to develop three unique windows.

1. Front Window.
2. Login Window.
3. Industry Window.

FRONT WINDOW

Front window presents data in an organized table shown below and which includes the following data. The variables in InTouch are called TAGS. The data are:

INDUSTRIES	WATER IN-FLOW liters/h	TOTAL VOLUME M3 Liters	EFFLUENT OUT-FLOW liters/h	TOTAL VOLUME M3 Liters	STATUS	WATER SUPPLY	ELECTRICITY SUPPLY	TREATMENT CHARGE Rs/m3
INDUSTRY 1	0	10.00	34	3.20	●	BLOCKED	●	31
INDUSTRY 2	0	0	0	0	●	NORMAL	●	0
INDUSTRY 3	0	0	0	0	●	NORMAL	●	0
INDUSTRY 4	0	0	0	0	●	NORMAL	●	0
INDUSTRY 5	0	0	0	0	●	NORMAL	●	0

Figure 1. Front Window

Table 1

S.no	Tag	Type
1	IFS#	I/O Real
2	ITV#	Memory Discrete
3	OFS #	I/O Real
4	OTV#	Memory Discrete
5	I#	Memory Discrete
6	P#	Memory Discrete
7	Logout	Memory Discrete

LOGIN WINDOW

Login window serves as a security authorization window which is the only gateway to gain access to change the parameters, values and control limits. Which also provides manual control at any critical strategies.



Figure 2. Login Window

Login window has three tags

1. For the username there is a textbox is used with the tag name “User”.
2. For the Password another text box is used with the tag name “Pwd”.
3. For the login purpose there is a detend button is used with the tag name “Logon”. The Login button will work only if the username and password is a match and it leads to the Front window.

Table 2. Login Tags

S.no	Tag	Type
1	User	Memory Message
2	Pwd	Memory Message
3	Logon	Memory Discrete

INDUSTRY WINDOW

The Industry window monitors and controls a single industry 24*7. Based on the number of industries this window can be added and by doing which all the industries can be monitored and controlled efficiently.

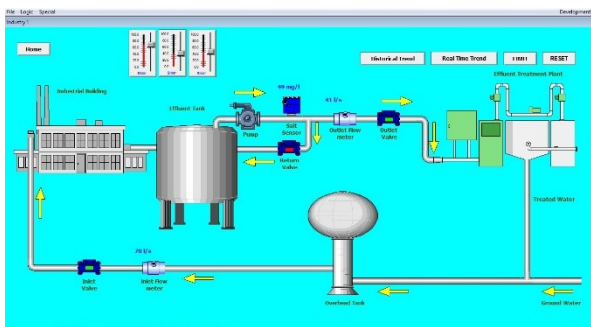


Figure 3. Industry Window.

Industry window consists of the following components

Detend Buttons

Home

When this home button is pressed it navigates to the user to the Front window.

Reset

Reset button resets the Inlet total volume and outlet total volume to zero.

Limit

Limit button opens a pop-up window which allows the user to modify the limits and login information.

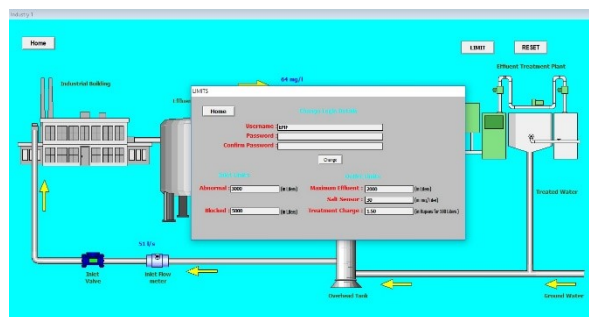


Figure 4. Limit Window

Real time trend

Real time trend button opens a window which contains the graphical monitor of real time variables. (E.g. A graph show the current values of inlet flow meter, outlet flow meter and salt sensor)

Historical trend

Historical trend button opens a window which contains the graphical monitor of the variables and which allows us to set the time period. Because of this reason it can be used to see the values of the variables in the past at a particular time.

Tags used for Industry window.

Table 3. Tags for Industry Window.

S.no	Tag	Type
1	IFS#	I/O Real
2	IV#	I/O Discrete
3	OFS #	I/O Real
4	OV#	I/O Discrete
5	SS#	I/O Real
6	RETV#	I/O Discrete
7	Limit1	Memory Discrete
8	Reset	Memory Discrete

9	Username	Memory Message
10	Password	Memory Message
11	Confirm Password	Memory Message
12	Change	Memory Discrete
13	Abnormalstate	Memory Real
14	Blockedstate	Memory Real
15	Maxeffluent	Memory Real
16	Saltsensor	Memory Real
17	Treatmentcharge	Memory Real

All of the tags are used and initiated using the window script feature of Intouch Software. Scripts are not included in this document.

2.2 WPLSoft (Delta PLC)

WPLSoft is a software for PLC (Programmable logic controller). When PLC is in operation, use WPLSoft to monitor the set value or temporarily saved value in timer (T), counter ©, and register (D) and force On/Off of output contacts. PLC is a control system using electronic operations.

WPLSoft Programmable Logic Controller or programmable controller software is a digital computer interface used for automation of typical industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures using Delta PLC's. PLCs are used in many industries and machines. PLCs are designed for multiple analogue and digital inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. The functionality of the PLC has evolved over the years to include sequential relay control, motion control, process control, distributed control systems and networking. The data handling, storage, processing power and communication capabilities of some modern PLCs are approximately equivalent to desktop computers.

Application of WPLSoft in Management of Effluents in Industries.

WPLSoft is the main controlling software of the DELTA PLC. We used the DVP28 SV for the controlling. In addition to that DVP 04AD is an analog extension module which is also added to read the flow meter reading.

The WPLSoft is used for reading the Analog value of the flowmeter and scaling it for our convenience.

There are two main instruction is used for interfacing the analog module with the PLC.

- 1.FROM
- 2.SCLP

1.From instruction is used for reading the data from the extension module.

2.SCLP instruction is used for scaling the read data to our convenience.

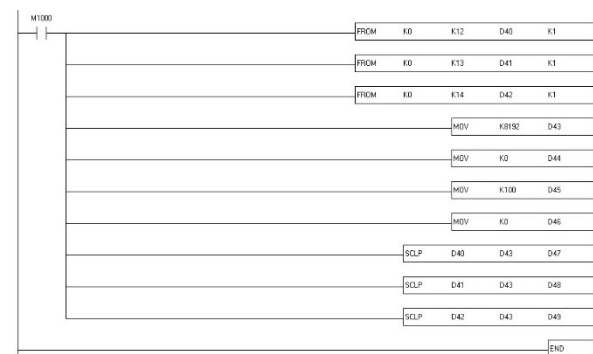


Figure 5. PLC Program

2.3 KEPServer

KEPServerEx falls under the category of a “Server” application. It is very common to hear the term “client/server application” in use across many software disciplines and business segments. In the industrial market, it has usually come to mean the sharing of manufacturing or production data between a variety of applications ranging from human machine interface software and data historians, to large MES and ERP applications.

Application of KEP server in Effluent Management system

KEP server is used in Effluent Management system as the interface between PLC and SCADA. And all the major communications settings and the interface between all the major components are provided using this application.

III. WORKING

MONITORING

For the data monitoring purposes, we use our SCADA screen developed for the project. SCADA (supervisory control and data acquisition) is a type of control system in software. Most of the control systems in industries are computer-controlled systems that monitor and control the real time processes in industries that exists in the physical world. SCADA systems steadily differentiate themselves from other control systems by being large scale processes that can include many numbers of sites and cover much distance. The type of PLC chosen here is Delta DVP 28 series SV.

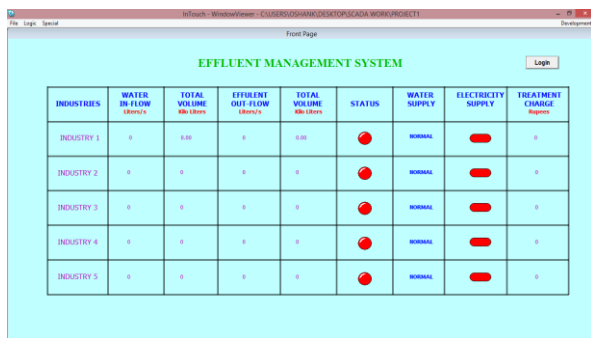


Figure 6. Data Monitoring Screen

The Figure 6 provides all the information about the water intake, outlet and Effluent across various industries. In our screen there are five industries whose water intake and outlet, monitoring has to be performed.

The monitoring of the industries is performed based on the input parameters predefined earlier. The screen shows the continuous intake of the water in terms of its flow and the whole of the water intake done by the industries. Which basically means the total quantity of water intake by the industries in kilo

liter's. Now for the outlet, the screen shows the details of the flow of effluent and amount of effluent sent to the treatment plant in kilo liter's.

The status column indicates, whether the industry is functional or dormant. The red light indicates that the industry is not functional and whereas the green light indicates that the industry is functional.

The water supply status provides the information on how the industry is consuming the water. If the water supply status NORMAL, then the industry is consuming the water as per the limit provided to them. When the status of the industry turns to ABNORMAL, then it indicates that the industry is consuming water more that its limit. But this consumption of water is under tolerated level.

That is, an industry is provided with a limit to consume the water and a little more than that limit is tolerated. When the industry starts to consume even more than the tolerated level then the water supply status turns to BLOCKED.

The electricity column provides the status of industries current electricity supply. When the indication is green, it implies that the industry is provided with the electricity supply. When it turns to red, the electricity supply of the industry has been terminated either due to higher consumption of water or due to irregular electricity supply.

The treatment charge column, provides the information such as the necessary amount of money to be paid by the individual industry for the effluent treatment. The treatment value differs based on the value provided by the effluent treatment plant. The function of the monitoring screen is very simple. It just provides the information as per the data collected. And the changes are made accordingly in the screen. For further control, the concerned person who is responsible for the control must Login.

DATA ACQUISITION AND RESET.

Data acquisition is an essential task performed by the SCADA. In our project, the data acquisition is based on the limits set earlier. In the fig 4.2, we can set the limits for the inlet and outlet of the water. The screen works as follows. The industry can start its water intake at any time. But the outlet of the industry is displayed only after consuming the quantity of 1 Kilo liter's. The water at outlet is measured using outlet flow sensor and the water contamination level is checked using Salt sensor. When the limit of the salt sensor is reached, it represents the water contamination level. Thus, the outlet water doesn't stay in the industry, rather it is transferred to the effluent treatment plant.

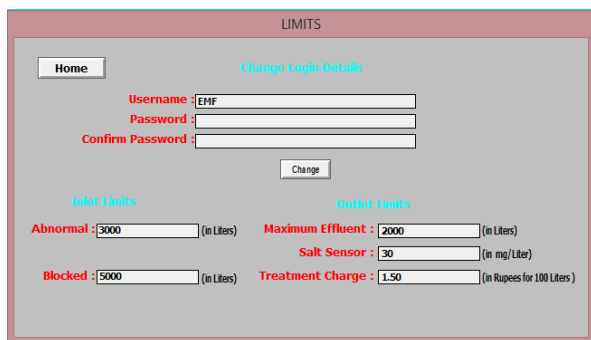


Figure 7. Limits Screen

In real time, the data's will be collected from the actual flow sensors and salt sensors. But in our project, we use potentiometers for representing the changes or to provide some variation. The tag name is allotted with the memory of the register in which the analog value of the potentiometer is obtained. This tag is connected to our PLC and SCADA using an interfacing software known as KEP Server. This software creates a path for accessing the register from both the software.

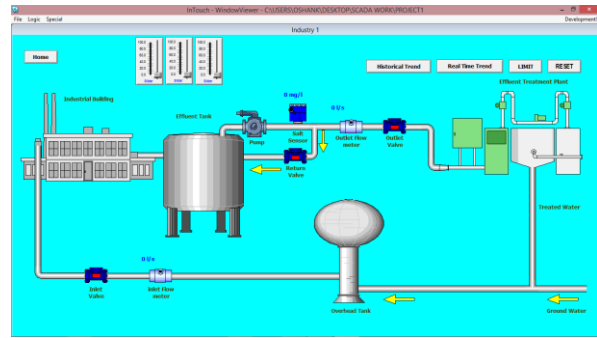


Figure 8. Reset control in INDUSTRY page

Well, the Fig 4.3 provides the details of the process happening in an industry. This screen resets itself for every 24 hours. And so, the industry can start its fresh water intake from the beginning of the next day. The data's such as industry's water intake, outlet, and the treatment charge for the effluent are the values that get reset at the end of every day.

AUTOMATIC AND MANUAL CONTROL

The automatic control is provided based on the limits provided earlier. But the controls can be done manual too. When the industry intakes a large quantity of water, exceeding the tolerated value. Then the electricity supply for the industry is terminated. This termination will only reset at the end of the day. But, when the industry makes a plea then the government has the authority to provide back the electricity to the industry. Thus, we provide a manual control for this purpose. The screen is fully automated and also provided with manual control.

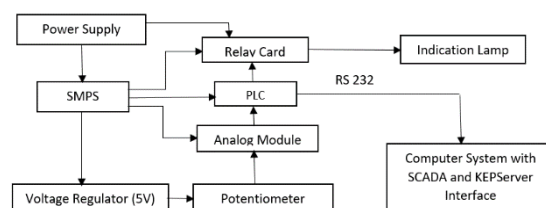


Figure 9. Block Diagram

The Figure 9 represents the block diagram of our system. The limits set once will always be set for further use. As the data are stored in retentive condition. The data's such as maximum effluent outlet, salt sensor value, treatment charge, abnormal state and blocked state are predefined once and the values

don't reset every day. These values can be used until the functioning of the screen. To provide any changes in those values, we can use the limits screen from the Industry page and the limits accordingly. This is manual changing of the limits as per the requirement. The electricity supply and also the excessive effluent flow to the treatment plant can also be provided manually by adjusting the limits. All these works are to be performed by the concerned personnel from the government point of view.

TREND MONITORING

TREND meter is based on standard measurements and data export methods. The TREND meter provides you with easy to read, graphed energy consumption and load information of each measured device. The TREND meter represents the starting point towards a more complex tool able to monitor a network infrastructure and to trigger energy saving techniques when traffic conditions change. Our tool has been developed inside the context of the European project TREND (Towards Real Energy Efficient Network design), which actually supported this work. The main goal of the TREND meter is to collect measurements of power and utilization from a variety of devices located in the Internet. The idea is to build a centralized server which collects the measurements from the devices. As second goal, the TREND meter aims at consolidating these measurements together to study whether there are similarities or not in the patterns of power and utilization of the devices. Additionally, the TREND meter aims at making publicly available the collected data to the community, and to easily show this information with a graphical representation. The design of TREND meter architecture had to face a complex and very heterogeneous scenario. The fig 3.5 shows the real time data monitoring.



Figure 10. Real Time Trend

SCADA is a high-performance trending application that supports real-time trending, historical trending and archival playback. The SCADA system has the ability to trend any real-time, calculated or application generated data value from the system database. The Trend Archiver has the ability to sample and periodically archive data as fast as every two seconds. Efficient compression techniques are used to save data to disk—and data is organized into monthly files which can be permanently archived onto external media for regulatory purposes.

SCADA TRENDS FEATURES

- ✓ Support for horizontal or vertical trending.
- ✓ Support for moveable crosshair for reading data values on a graph
- ✓ Scalable to all industrial manufacturing and infrastructure operations.
- ✓ Supports Business Continuity initiatives.
- ✓ Transforms the time-series process data into actionable information for faster, more accurate decision-making.



Figure 11. Historical Trend

The figure 11 shows the historical trend graphical representation of the overall process for the future

reference. The historical trending supports the storage of trend data for an unlimited period of time. Archived data can also be exported as CSV formatted files for supplementary analysis or for importing data into reports. In real time trending, the values that are monitored consecutively are represented in the form of graph at that particular instance. Whereas in historical trends features, it shows the range of values at a given instance. The real trends are mobile which means that its values change periodically. But for historical trends, it shows the range of values at particular instances for our referral view.

IV. RESULTS AND DISCUSSIONS

CONCLUSION

This project effectively promotes high portability and provides a simple way to monitor the process on the go. The proposed project is completely safe from unauthorized personnel as security username and password are provided to ensure process safety. Practically there would be a time delay in control which could be not more than few milliseconds. The main factor holding the project up straight is the modification and development which could be made possibly with available resources. By using automation based on PLC & SCADA we can increase productivity & also reduce monitoring based on humans done in dangerous environment. Benefit of replacing human for Monitoring and Data Acquisition in plant reduce operation time & increase consistency of output.

FUTURE SCOPE

This project can be modified based on the required condition and control can be made a lot easier. The processes could also be viewed in LabVIEW by making necessary interfacing works with the SCADA. The interfacing with LabVIEW is made to monitor the trends. It is also possible to view the process graphs, data's and desired specific parameters on an android device by developing an application dedicated for the process. With the usage of a GPRS

module, this project can be a made lot more useful as it will provide long range data acquisition, data monitoring and process controlling.

APPLICATIONS

- ✓ This screen is used to monitor and control various Plant operations.
- ✓ It can be used by PWD of India for proper monitoring over various industries.
- ✓ It can be used wherever the supervisory control is necessary.
- ✓ It can be used in power plants, industries where data monitoring and control over long range is an absolute necessary.
- ✓ It can be used in Chemical process plants.

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