

# WASTEWATER TREATMENT INFORMATION TECHNOLOGY

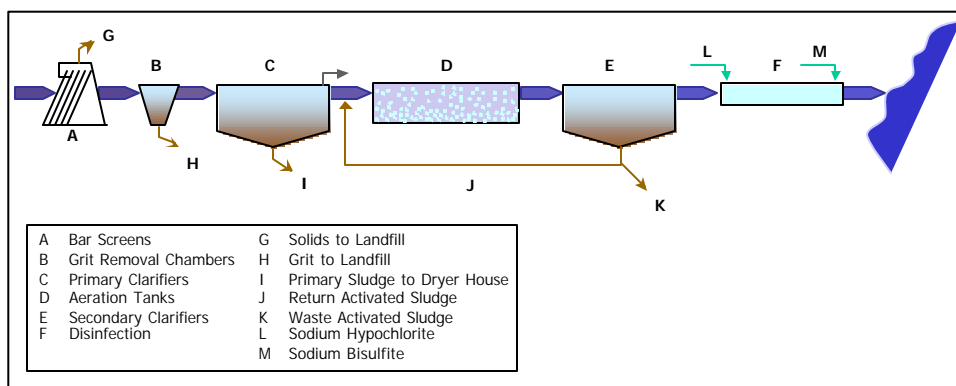
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on the application of Proficy for Water Treatment

SUEZ, parent company of United Water – ONDEO, is one of the largest water and wastewater treatment firms in the world. On January 5<sup>th</sup>, 1998, United Water – Milwaukee signed a 10 year Public-Private partnership with the Milwaukee Metropolitan Sewerage District (MMSD). As part of the contract, United Water – ONDEO operates and maintains MMSD’s two wastewater treatment plants (Jones Island and South Shore), maintains the sewer interceptor system and the deep tunnel storage network.

Each wastewater treatment plant has a design capacity of 350 and 300 MGD, with an average capacity of 100 – 150 MGD. Jones Island and South Shore wastewater treatment plants work with a preliminary treatment consisting of bar screens and grit removal chambers, primary clarifiers, activated sludge treatment and a tertiary treatment of

disinfection with sodium hypochlorite. The sludge is treated differently in each plant. Jones Island’s sludge is dried to produce MILORGANITE biosolids fertilizer. South Shore’s sludge is anaerobically digested to produce a soil conditioner, which is used on farms in Southeastern Wisconsin.

The sewer interceptor system covers 28 communities covering over 420 square miles both inside and outside Milwaukee County. The “Deep Tunnel” network consists of a 17-mile tunnel located about 300 feet below ground and ranging in diameter from 17 to 32 feet, with a storage capacity of 410 Mgal. It was designed to store under extreme wet weather conditions the excess water flow when it is higher than the plants’ capacity.



## Y2K Bug

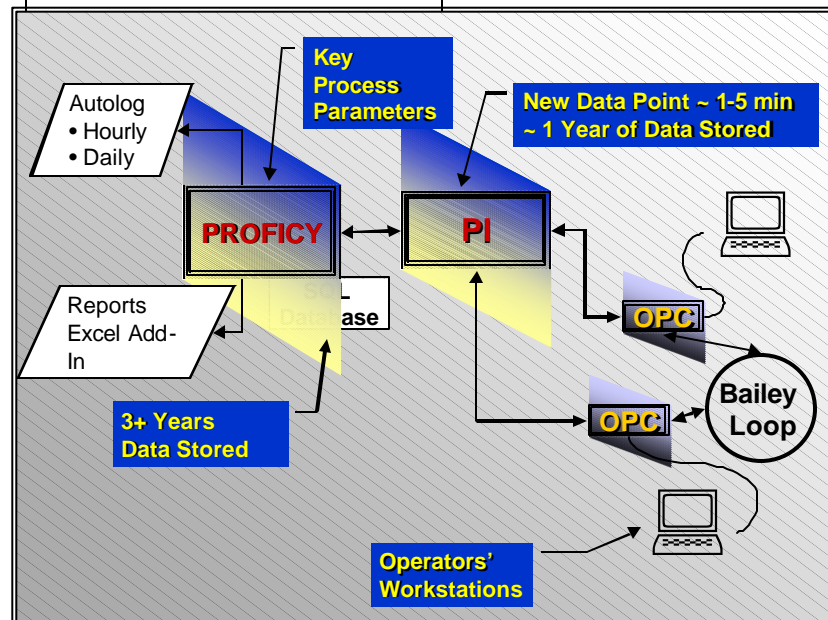
A thorough analysis of the process information systems at South Shore and Jones Island plants showed that the information systems used were not Y2K compliant, therefore the Information & Control personnel from United Water Milwaukee and MMSD searched for a solution that meets the following requirements:

- A real-time graphic interface similar to the one already in use, familiar to the operations' personnel and able to display the process information all across the plant on the operations' workstations;
- A database historian that could handle all the process parameters and that could store at least 1 year of data; and
- A reporting system that could be both

straightforward and reliable.

After analyzing several options, United Water together with MMSD chose the following systems. For the real-time graphic interface the workstations use Intellution and iFIX software. The historian chosen was "PI" process information system from OSI Software, San Leandro, California. The Proficy software, from Mountain Systems, was chosen as a reporting complement to the PI system. This way "PI" is used to keep a history of all the plant data and Proficy stores

the key performance indicators and key data, that with its Excel Add-in package is used to build the production and environmental compliance reports. Another important component of Proficy are the Autolog displays to manually enter new data into the databases, and display process summary data, which gives more flexibility to the system. "PI" and Proficy store the data in a SQL database. This opens a wide range of opportunities to manipulate the data by using SQL compatible script.



## **Proficy System Definition**

Wastewater treatment has a difference with other industries that use the PI and Proficy software, it has only one product: Treated Water. So instead of defining different products with batch production and formulations, as it is done at other facilities, the system was defined with one single product: Water Treatment, and all parameters were defined as time based variables. This allows an analysis of the change of parameters with time and the introduction of limits and specifications on each one. United Water – Milwaukee wastewater treatment plants collect data from

its monitoring equipment on a continuous basis. This data, generated on time ranges from 1 to 5 minutes, is stored in the PI database. This means that PI stores from 1440 to 288 data points per parameter. This amount of data is not easily analyzed unless it is summarized and combined. Proficy database is designed to collect the data from the PI database. Proficy database is set up to collect the required information from PI to store only the summarized data, like daily values, maximums, minimums, etcetera. Most Proficy variables were defined as daily data, since at this water treatment plant most of

the required reports display daily data, which is analyzed regularly. In the case of some of the regulatory compliance reporting requirements, the data was defined under different time ranges.

For an easier handling of data the Proficy system was divided by unitary process, i.e. Raw Sewage, Preliminary Treatment, Secondary Treatment, Sludge Thickening, Sludge Drying, and Laboratory Data. The variables were organized inside each process by sampling type: Hourly data, Daily data, Maximum, Minimum, Calculations, etcetera.

## **Reporting Systems**

Wastewater Treatment plants have stringent reporting requirements, both for internal use and

for governmental and private entities. Jones Island and South Shore have to present monthly performance reports to MMSD, the client, annual and semiannual

reports to the regulatory agencies, and prepares daily reports for operation review.

The first reporting system to be developed was for South Shore, since its former reporting system was not Y2K compliant. A 44-page report was prepared. This report was divided in three areas: Purification, Solids and Chemicals. Parallel to these reports a Daily Exception Report was developed. Taking advantage of Microsoft Windows and Excel Visual Basic capabilities the 44-page report is archived at the end of each month in three different formats: a monthly report with all the daily values, plus the monthly averages, maximums, minimums and totals; a year-to-date

report including all the daily values per parameter; and an annualized report which includes all the monthly averages, maximums, minimums and totals per parameter. These archived reports allow personnel to analyze and view the data without a connection to the process network or to the PI – Proficy software, since they would only require Microsoft Excel.

The Daily Exception Report is used to analyze the daily plant performance, therefore it includes key performance parameters and laboratory data that allows the operations

department the evaluation of the plant efficiency and performance. This report includes:

- Plant influent flow
- Daily laboratory data: BOD, TSS, Phosphorous, Chlorine, Fecal Coliform and Ammonia, together with the weekly rolling average value and the monthly average.
- Primary treatment data: Sludge concentration and % total solids
- Secondary treatment data: Aeration dissolved oxygen, MLSS, MCRT, SVI, Blanket level and RAS.

The Purification portion of the report includes parameters like:

- Process hydraulic characteristics;
- Temperature
- Laboratory data: BOD, TSS, Ammonia, etc.
- Diversions inside the process
- Number of units in service
- Chemical application efficiency
- % Removal efficiency
- Blanket levels
- Performance indicators: SVI, MCRT, MLSS.

The Solids portion of the report includes:

- Sludge flow, mass and concentration through the process
- Pumps flow and pressure
- Laboratory data for digestion process: % Volatile solids, % Volatile acids, Alkalinity, pH.
- Digestion process parameters: Volume, loading, residence time, gas production
- Sludge dewatering, capture, storage and disposal.

The Chemical portion of the report includes:

- Chemical inventory
- Shipments received
- Daily usage, metered and inventory based
- Dosages
- Residuals and concentration

South Shore takes data from the monthly reports to build their monthly performance report to the MMSD and their annual regulatory reports. This way all the data is centralized. It makes it easier to build the required reports having a base for the data that everybody agrees on.

Jones Island is starting to build their own monthly report based on the experiences of South Shore. Their current reporting system is Y2K compliant therefore there was no hurry in making the change, though they have seen the advantages of having a centralized report like the one at South Shore and are shifting to this kind of system. They started with their sludge management system. The sludge drying process is very

important for Jones Island since it produces the commercial product: MILORGANITE. Both for the client and for United Water keeping this process controlled is a focal activity. That is why they selected this process when starting with the Proficy reporting system. They included the properties of the sludge mixture: Primary, Secondary, Digested coming from South Shore and Thickened Secondary. The composition of the sludge is crucial to the final properties of MILORGANITE. With this partial report Jones Island controls not only the sludge going towards the belt filter presses, that prepare the blended

sludge for the drying process, but also the efficiency of the clarifiers and the secondary sludge thickening. Currently they are working on adding the purification and chemical reporting sections to the sludge handling report.

Plant Area/Indicators	Limits	Target	Actual
PLANT FLOW (MGD)			125
<b>PLANT EFFLUENT</b>			
<b>TSS (mg/l)</b>			
DAILY	45	10	9
TO DATE WEEKLY AVERAGE	45	10	11
TO DATE MONTHLY AVERAGE	30	10	10
<b>BOD (mg/l)</b>			
DAILY		10	8
TO DATE WEEKLY AVERAGE	45	10	9
TO DATE MONTHLY AVERAGE	30	10	11
<b>FECAL COLIFORM (100 ML)</b>			
MOST RECENT VALUE		80	50
TO DATE MONTHLY G/M	400	80	70
<b>PHOSPHORUS (mg/l)</b>			
MONTHLY AVG	1	0.7	0.8
<b>pH</b>			
DAILY	6.0-9.0	7	6.8
WEEKLY AVERAGE	6.0-9.0	7	6.9
<b>NH3 (mg/l)</b>			
WEEKLY AVERAGE	6.7-16.7	1	0.8
<b>PRIMARY TREATMENT</b>			
THICKENED SLUDGE CONC %		4%	3.8
TSS % REMOVAL		50%	50
<b>SECONDARY TREATMENT</b>			
AERATION D.O.		3	2.7
MLSS (mg/l)		1700	1900
MCRT (days)		5.5	6
SVI 7 DAY AVG		100	110
BLANKET LEVEL (feet)		<1.5	1.5
RAS SS (mg/l)		9000	9500
<b>DISINFECTION</b>			
CHLORINE DOSE (mg/l)		1.2	1.5
CL2 RES. BEFORE DECHLOR S (mg/L)		0.5	0.7
CL2 RES. BEFORE DECHLOR N (mg/L)		0.5	0.7
CL2 RES. AFTER DECHLOR S (mg/L)	0.1	0.05	0
CL2 RES. AFTER DECHLOR N (mg/L)	0.1	0.05	0

### **Air Emission Regulatory Reports at Jones Island**

In 1996 Jones Island built a new Dewatering and Drying house for MILORGANITE production. From this

time till the year 2000 they operated with a Wisconsin Department of Natural Resources construction permit. In July 2000 an air pollution control operation permit was granted for the Dewatering and Drying

facility in Jones Island. This permit requires an annual Compliance Report and a biannual Monitoring Report. The permit controls several emission parameters, including particulate matter, sulfur dioxide, visible emissions,

nitrogen oxides, carbon monoxide, and volatile organic compounds, among others. The monitoring of these parameters required a continuous monitoring of the air control equipment and the dryers. Several indirect indicators were selected to point out the compliance with the permit requirements. The following indicators were selected:

- Fuel and natural gas consumption, daily and weekly,
- Start-up and shutdown times and hours of operation of dryers and baghouses.
- Operating dryer temperature. This should not exceed 210°F for periods longer than 10 minutes.
- Baghouse differential pressure, influent, and out flow temperature, and alarms.
- Wet electrostatic precipitators (ESP) primary current and secondary voltage.

### Next Steps – United Water

United Water has observed the good

All parameters, except the fuel and natural gas consumption and the blended sludge processed, required a report of the maximum 10 minute average over 8 hour periods.

The monitoring report was developed in Excel with the Proficy Add-In. Most parameters used Proficy and PI databases for the number generation. The numbers were displayed on a monthly layout in Excel. The use of embedded Excel equations facilitated the display of the right numbers, and times of start-up and shutdown of equipment. A series of equations using PI and the Proficy add-in was used for the identification of the times when the operation temperature was higher than 210°F in average over a period of one hour, a permit

requirement. PI equations were used to calculate the total hours of operation of the equipment each month. All weekly and monthly averages were calculated using Excel equations. With the inclusion of Visual Basic macros a system was developed so that the report be generated and printed each month.

TABLE 4. DRYER PRODUCT TEMPERATURE					
Each value is calculated as the 8 hour maximum of the 10 min average.					
DATE	SHIFT	DRYER 1 TK252401.PV 249 F	DRYER 2 TK252402.PV 250 F	DRYER 3 TK252403.PV 251 F	DRYER 4 TK252404.PV 252 F
1/1/01 00:00	1	150.00	150.00	187.97	150.00
1/1/01 08:00	2	150.00	150.00	185.89	150.00
1/1/01 16:00	3	150.00	150.00	208.42	150.00
1/2/01 00:00	1	150.00	150.00	202.29	150.00
1/2/01 08:00	2	150.00	150.00	202.49	150.00
1/2/01 16:00	3	150.00	150.00	186.99	150.00
1/3/01 00:00	1	150.00	150.00	199.57	150.00
1/3/01 08:00	2	150.00	150.00	205.53	150.00
1/3/01 16:00	3	150.00	150.00	208.67	198.85
1/4/01 00:00	1	150.00	150.00	197.47	199.64
1/4/01 08:00	2	150.00	150.00	195.25	191.00
1/4/01 16:00	3	150.00	150.00	187.37	188.86

TABLE 2. DRYERS				
DATE	DRYER 1 QL251401_Int	DRYER 2 QL251402_Int	DRYER 3 QL251403_Int	DRYER 4 QL251404_Int
1/6/01	425	429	430	431
1/6/01	410	411	412	413
1/7/01	12-31-00	OUT	OUT	IN
1/7/01	1-1-01	OUT	OUT	IN
1/7/01	1-2-01	OUT	OUT	IN
1/8/01	1-3-01	OUT	OUT	IN
1/8/01	1-4-01	OUT	OUT	IN
1/8/01	1-5-01	9:56	OUT	IN
1/8/01	1-6-01	IN	OUT	IN
1/8/01	1-7-01	IN	OUT	IN
1/8/01	1-8-01	IN	OUT	IN
1/8/01	1-9-01	IN	OUT	IN
1/8/01	1-10-01	IN	13:45	IN
1/8/01	1-11-01	IN	IN	IN
1/8/01	1-12-01			

match PI and Proficy have for the application on Wastewater Treatment facilities. They are able to analyze

real time data directly on their workstations and have the ability to combine data from different sources for

comparison and efficiency analysis. With the Proficity reporting systems they acquire a simpler and more flexible system that can be modified by their own personnel to adapt to changes in the process. The advantage of using Excel as the base for the reporting system is the already acquired knowledge the employees have of the software, making it easier for them to understand the equations and to manipulate the report itself. This makes it easier to teach the different applications Proficity can have on the plant.

By the end of the year 2000, United Water is going to connect their business and process

networks. This connection is going to enable the review of all Proficity reporting systems from all the business and process workstations, independently if it's on Jones Island or South Shore. Jones Island is currently modifying their reporting system to include in the Proficity database the whole reporting requirements to bring it to the same level as a South Shore reports.

All process operators are going to be trained on the use of Proficity manual entry displays. This will reduce the time the data clerk uses on data entry operations and will allow the operations personnel to view daily calculated

data from their workstations.

The next step is to apply PI and Proficity to the sewer interceptor system and the deep tunnel. Intellution and iFIX are going to be used for the real time graphic displays. New reports are going to be developed for operations and for regulatory requirements. With the connectivity project, in which they are going to join the process and business networks the whole United Water – Milwaukee project is going to be in a homogeneous data system that can be reviewed and analyzed from any computer in the project.

**Nomenclature:**

BOD	Biochemical oxygen demand
Cl <sub>2</sub>	Chlorine
D.O.	Dissolved oxygen
MCRT	Mean cell residence time
MLSS	Mixed liquor suspended solids
MMSD	Milwaukee Metropolitan Sewerage District
NH <sub>3</sub>	Ammonia
RAS	Return activated sludge
SS	Suspended solids
SVI	Sludge volume index
TSS	Total suspended solids
WAS	Waste activated sludge