Friendly Environmental Oily Water Treatment System

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Abstract— In this paper we simulate the total operation of friendly environmental oily water treatment system by using a ladder logic Siemens S7.this system is implemented to make sure anticontamantion for sea water to keep the marine life safe. In this system we have two pumps to control the level of Tiled Plate Interceptor (TPI) separator, we have four states for this (TPI) which are (HHL,HL,LL,LLL) according to the states of this TPI control the other pump of the sump the TPI is connected to two separated filters to remove the duster and impurities the operation of this two filters depends on differential pressure of transmitter .we have three states to differential pressure transmitter (P1>P2) Or (P2=P1)in normal operation whenP2>P1the valves of back wash system open to wash filters from downstream in our research .we used a strict closed loop to make sure that the contamination is reduced to the lowest predetermined environmentally allowed level .

Index Terms— PLC, Polusion, Control system, Friendly environmental system, Ladder logic, Water treatement

1 INTRODUCTION

Oil water separator package has the purpose to produce a outlet water flow with the Following characteristics: Total oil content: Max 10 ppm, TSS content: Max 20 ppm, Phenol: Max 0,005 ppm, PH: 6-9 .The Oily water separator/Oil skimmer package is composed by the oily water is conveyed in a open drain sump where Installed a floating skimmer in order to remove the superficial mineral oil from oily Water. The separated oil is sent, through a mono screw pump, to recovered oil sump while the oily water is sent, through submersible pump to TPI in order to further reduce the oil content. From TPI, the raw water is sent to two activated carbon/sand filters where the solid Suspend content is reduced to 20ppm and the phenol concentration is reduced to 0,005ppm.To assure a phenol concentration less than 0,005ppm the filtered water is treated with Hydrogen peroxide (around 10% w/w). In sewage treatment process the plc. Is the core of the industrial equipment constitute in the entire control system network the combination of computer and PLC [1] Consist a network control system throughout the system it includes flow diagram design Interface design I/O site selection and preparation processes of PLC. Program Control function of the valve the valve control essential in the process of water treatment at present use the relays to operate the valve is the principle means open valves and off is the two movements in the process of the control that corresponds to normally open and closed push buttons switch of relays Set the limited valve first when the valve is opened greater than the limits the output contact s to open the valve action otherwise it will reset the valve for each valve open or closed it will get the value of the sensor and transmitted it to the plc. The result based on the actual specific situation by the PLC.

2 NORMAL OPERATION

Pump of the sump get the oily water in TPI separator when it gets to level high it start the pump then stop pump of the sump at level high high to take it to the carbon sand filters when TPI separator reach to level low start the pump of the sump & at level low low and stop pump of TPI separator at level low to confirm on continues operation their differential pressure transmitter measure the (ΔP) When more than 2 bar backwash system is enter in operation by closing the normal operation on off valves and open the on off valves of the back wash system the (ΔP) will be lost due to P1<P2 so the result will be less than 2 bar so left the back wash operation for 10 minutes by using timer then go to PH analyzer which analogy input measured (4-20 mA) if the 7<PH<9 if ok open the on off valve of clean sump if not open the on off valve return to oily sump[1,3,4]

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2.1 TPI SEPERATOR SYSTEM:

There is a level transmitter TPI separator which it has limits at measuring level, LH start pump 034A/B LHH to stop feed pump 010, LL to stop pump034A/B and LLL to start pump 010 again so we add function code by ladder logic for an analogy input AI which make and scaling ranging level transmitter by function block FC 105 then add comparators to put level limitations then we take these limitations (LHH, LH, LL, LLL) to DO digital output to start and stop pumps

2.2 Level transmitter:

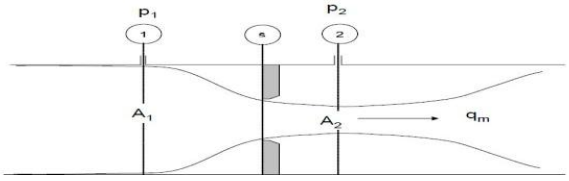
It is transmitter depend on pressure to measure level, flow&Δ P at HART (4-20mA) which is an extended diaghram with capillary internal liquid when the process press on the diagram liquid inside the capillary pressure on capsules produce an output with millivolts there is a specific gravity for liquid inside the capillary so we should after mounting the transmitter make zero trim and sensor trim (LT-001,PDT-001,FT-001) are mainly the same transmitter model 2051CD EMERSON but there function is difference, ranging and units due to the mounting of the transmitter

2.3 Filtration towers:

Adding the same block FC 105 for AI for PDT pressure differential transmitter for scaling and ranging the adding the condition (Δp) >2 bar so add comparators for PDT to give a control signal to on/off valves of backwash open and close for one of towers to not stop operation and leave this operation for 10mintues By add a timer if the alarm is still there I stop backwash on tower A and entered in normal operation then transfer to tower B to make back wash [1]

2.4 Differential pressure transmitter and relation to the flow rate

Flow rate is directly proportional to pressure and differential pressure (ΔP) Flow is forced through the orifice



$$\Delta P = \frac{1}{2}\rho\left(v_1^2 - v_2^2\right)$$

It is differential pressure transmitter measure signal from (4-20 mA) it is also extended diagram capillary fill with silicon when pressure applied on the diaphragm liquid is pressurized on capsules so produced a certain millivolts connected by communicator to make sensor trim or zero trim to correct the pressure offset and upper range value to match with pressure standard and to be accurate, zero trim useful to compensate the mounting effect of transmitter

2.5 Hydrogen peroxide system

The output of filtration towers pass on flow transmitter it take the quantity of the flow and then sends to variable speed pumps of H2O2 to take what equivalent to that flow by adding 3 liters for each 1metric cubic so we add AI and take result on AO by adding for both FC105 for ranging and scaling the add limitations of (FT 001) (FHH, FH, FL, FLL) connected to AO variable speed pump.

2.6 PH system

After adding the H2O2 it passes on static mixer then PH analyzer measures PH quantity in the water before Discharge on the sea 6<PH<9 so we add AI FC105 block for PH analyzer then add comparators to achieve conditions then go two DO digital outputs two on/off valves to choose which pass the flow it will take to oily sump or sea

2.7 PH analyzer

It is technique is flourscence occurs molecule when absorbs light energy either ultraviolet or visible or rapidly emits light at some longer wavelength flurometer is a filter based measure the ability to absorb light in narrow spectral region emit alight with longer wave length the light source launches excitation light in fiber optic cable the fiber optic cable transfer the excitation light to the fluorescence probe mounted in the process the probe launches the light in the sample and collect the molecular fluorescence (emission) then emission light transfer through the optic fiber cable to the analyzer then go to emission filter to remove the residuals excitation energy collected by fluorescence probe then go to detector to measure the intensity of the fluorescence Then move on span filter Measure Detector is consist of photomultiplier tube through photodiodes the light detected by photodiode the intensity proportional to the analytic concentration which registered by digital reading

Span filter fluorescence [10, 11]

Advantages:

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1-Most sensitivity because the fluorescence intensity measured by PPM OR PPB stands to parts per million or billon

2- Flurometer is highly specific and less susceptible to interference because fewer material exhibit fluorescence

3 PROGRAMMABLE LOGIC CONTROLLER

In this, instead of achieving desired control and automation through physical wiring of control Devices, it is achieving through program say software.

Advantages

Reduced Space, Energy saving, Modular Replacement, Easy trouble shooting, Error diagnostics Programmer, Economical, Greater life and reliability, The Compatibilities of PLC'S, Logic Control, PID control, Operator control, Signaling and listing, Coordination and communication. How PLC works Basics of a PLC function are continual scanning of a program. The scanning process involves three basic steps.

Step 1: Testing input status

First the PLC checks each of its input with intention to see which one has status on or off. In other Words it checks whether a switch or a sensor etc., is activated or not. The information that the processor thus obtains through this step is stored in memory in order to be used in the following steps.

Step 2: Programming execution

Here a PLC executes a program instruction by instruction based on the program and based on the Status of the input has obtained in the preceding step, and appropriate action is taken. The action might be activation of certain outputs and the results can be put off and stored in memory to be retrieved later in the following steps.

Step 3: Checking and Correction of output status

Finally, a PLC checks up output signals and adjust it has needed. Changes are performed based On the input status that had been read during the first step and based on the result of the program [2, 5, and 6]

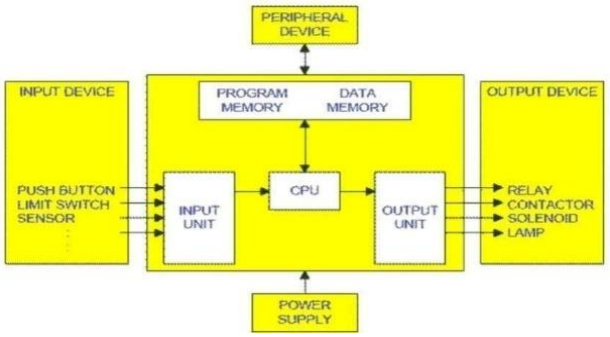

Fig.5 block Diagram OF PLC

System review:

We use Siemens step7 Power supply (307 5A):

1- Output current 5 A

2- Output voltage 24 VDC; short circuit-proof, open circuit-proof (Rated input voltage 120/230 VAC, 50/60 Hz)

3- Safety ISO on to EN 60 950

4- May be used as load power supply [7]

Fig.6 power supply of PLC

Fig.7 PLC processer CPU

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3.1 Mode Selector Positions

The positions of the mode selector are explained in the order in which they appear On the CPU. Details on
CPU operating modes are found in the STEP 7

1- RUN-P RUN-PROGRAM: mode The CPU scans the user program. The key cannot be taken out in this position.

FIG.9 RECHARGEABLE

73.2 Memory CARD

2- RUN mode RUN mode: The CPU scans the user program. The user program cannot be changed without password Confirmation. The key can be removed in this position to prevent anyone not authorized to do so from changing the operating mode.

3-Stop mode Stop mode: The CPU does not scan user programs. The key can be removed in this position to prevent anyone not authorized to do so from changing the operating mode.

4- MRES mode Memory reset: Momentary-contact position of the mode selector for CPU memory reset (or a cold start as well in the case of the 318-2).Memory reset per mode selector switch requires a specific

5- Backup battery/accumulator Exceptions:

The CPUs 312IFM and 313 do not have a real time clock so they do not need an accumulator Battery The CPU 312IFM does not have a buffer which means that you cannot insert a Battery Using a Backup Battery or Accumulator Rechargeable battery: The rechargeable battery is charged after CPU POWER ON a backup of the User program either on Memory Card or, in the case of must be created

6-CPU314IFM314 (-5AE0x-), on EPROM.

Backup Battery: User program (if not stored on memory card and protected against loss on power failure) More data areas in data blocks are to be retained than possible without battery the real Battery -

a memory card cannot be inserted with the CPUs 312 IFM and 314 IFM (5AE0x). These CPUs have an integrated read-only memory. Purpose of the Memory Card with the memory card and the load can be expand memory of your CPU.

The user program can be stored and the parameters that set the responses of the CPU and modules on the memory card.

Back up CPU operating system can be done to a Memory Card. except CPU 318-2.

The user program can be stored on the memory card, it will remain in the CPU when the power is off even without a backup battery [7]

3.3 Digital Module:

Fig10 digital module

Steps in selecting and commissioning the digital module the steps required to successfully complete commission of digital modules. You do not strictly have to adhere to this suggested sequence, that is, you can complete other tasks such as installing or commissioning other modules, or program the module at an earlier or later time

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1- Selecting the module

2- Installing the module in the SIMATIC S7 system

3- Assigning module parameters

4- Commission the configuration

5- Analysis the configuration if commissioning was not successful. [8, 9]

3.4 Analogy Module:

Analog module selection and commissioning sequence:

1- Selecting the module

2- for certain analog input modules: Set the measuring type and range using the measuring Range module

3- Installing the module in the SIMATIC S7 system

4- Assigning module parameters

5-Connect the measuring transducers or loads to the module

6-Commission the configuration

7Analyze the configuration if commissioning fail

4 SOFTWARE:

4.1 Hardware configuration:

The chassis should be standard order by adding power supply at first slot then processer at second slot and I put my I/O modules at rest of slots I open sematic program from file at toolbar choose new. another block open then I write the name of my project then go again to file icon at toolbar then choose open then go to insert icon at toolbar choose station sematic 300 Go to hardware on the page and implement your chassis by going to insert icon of toolbar at hardware config page press insert object [9].

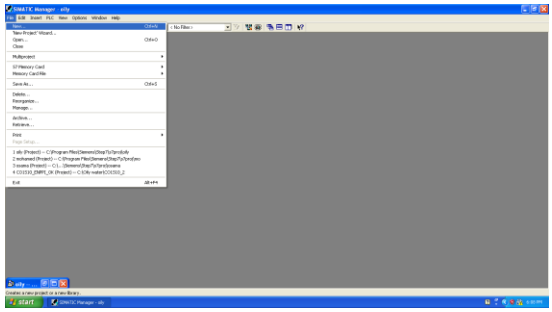

Fig.10 choose new file for your project

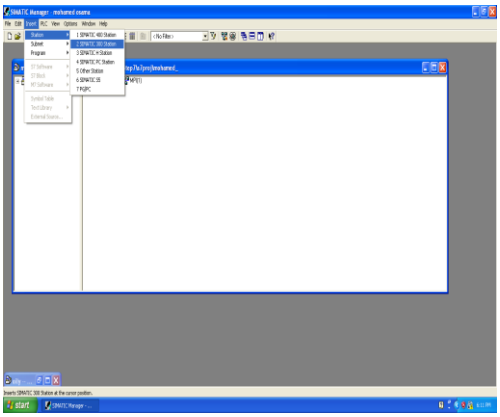

Fig .11 choose the type of your station

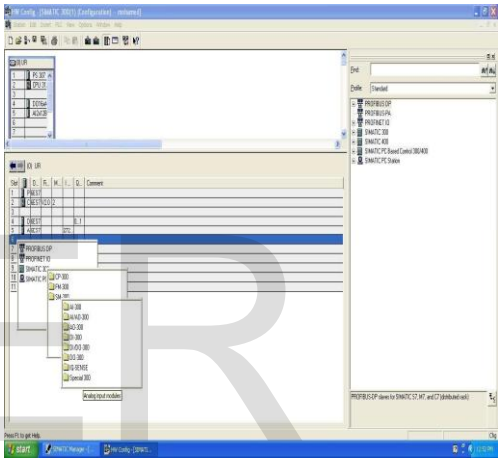

Fig.12 choose the rack

4.2 Software configuration

go on sematic manager page then go insert icon at toolbar then choose S7 program then go S7 blocks choose organization block [9] which call any function block and implement your program I use ladder logic language code and function block code I use FC 105 for scaling and then add my alarms (H,HH,L,LL)and their actions so I made standard block by ladder logic to be my Analogy input AI to be all level& flow& pressure differential transmitters and PH analyzer other one for analogy output AO for the variable speed pump of H202,Digital output DO for on off valves and pumps start and stop

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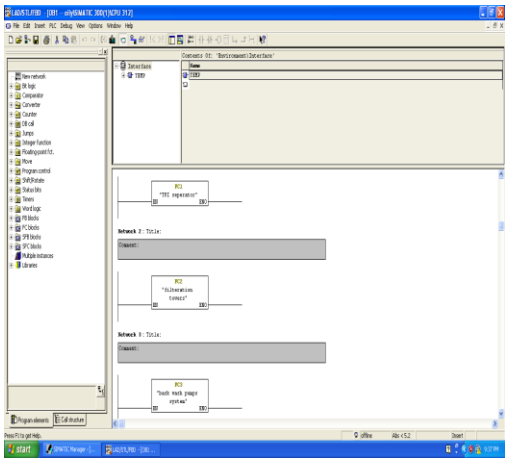

Fig .13 Function blocks of the program

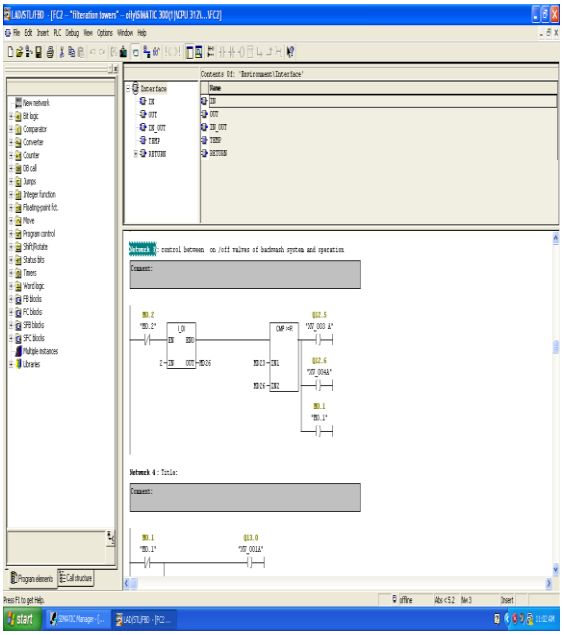

Fig.14 Adding conditions for operation and gets the output by opening XVs

Fig 14 organization block (OB) which calls all the the function codes block (FC)

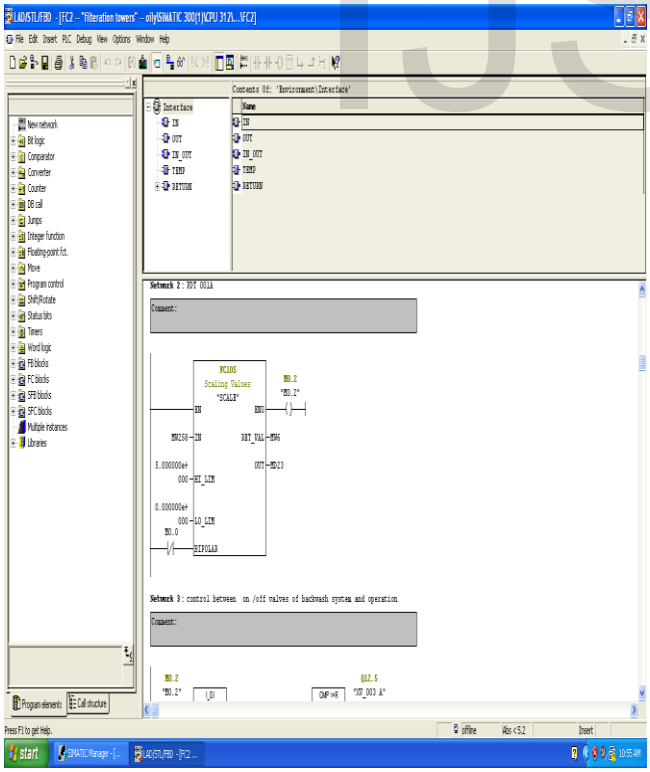

Fig .15 Modeling of scaling block FC105 for ranging of HI &LO limits

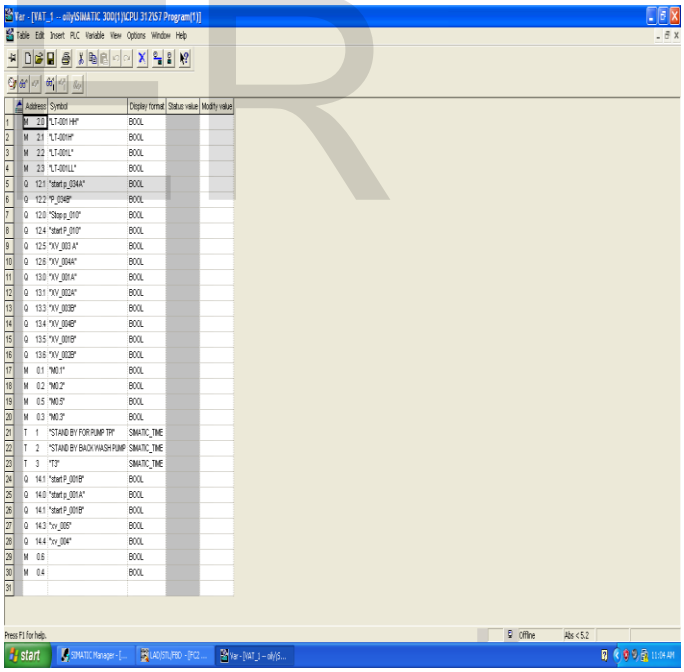

Fig.15 Variable table for all I/O signals which will be the reference sheet

5 CONCLUSION

From the analysis done, it was found that water impurities are discarded through the filters& adding H2O2 and reverse Siemens sys-

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tem and it is supported by the analysis result. Using PLC we have automated the water treatment processes and overcome the limitations of manual processing. The biggest advantage of using this system is the efficiency is 98%-99%, thus saving the precious resource, Water.

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