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Simulation program for automating the process of neutralization of aggressive waters using labview

Stelian Valentin Casavela

Automation, Computers, Electrical Engineering and Energy Department, University of Petrosani, Petrosani, Romania.

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ABSTRACT

This article contains, in the first chapter, a general presentation of an installation for neutralization of aggressive waters, which may resulted in some electrical thermo-centrals, as those from Deva-Mintia, Paroseni (Romania) etc., in removal of sulphur and by washing anion and cation filters, necessary for de-pollution. Before waters evacuation, the pH must be kept in the limits of neutral values. The automation command is redundant and needs a PC computer and a microcontroller, of Twido type, for example, produced by Schneider Company. We choose here to present what is inside the PC, where was installed a LabVIEW programming environment and where was created a simulation program, which works independently of process and of data acquisition modules and which was called Mintia.sim.vi. This simulates communications with inputs and outputs, through the NI ELVIS - Instrumentation, Data Acquisition and Prototyping for Labs modules. The second chapter presents the interfaces between PC and process: data acquisition modules and multiplexer module, connected in the PC USB port, which were either simulated or included in NI ELVIS. The third chapter contains the program short description, with its panel, offering controls and indicators, among whom being so called "tanks", which symbolize neutralization and consumption tanks (HCL and NaOH), which indicate, synchronously with physic reality, the reminded tanks filling or depletion. The start and stop controls command the equipment power supply and some virtual LED-s and messages inform permanently the operator about the filling-neutralization-depleting process running. Consequently, the panel is both an operative and a synoptic one.

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Introduction

Aggressive waters may resulted from HST (Hot Steam Tanks) chemical washing, condensation and treating of various filters and chemical treating of waters accumulated in Blow Down Tanks. Neutralization is made by mixing up these waters with an acid reactive (most frequently HCL), in case of a basic pH, or with a basic reactive (most frequently NaOH), in case of an acid pH. The aggressive waters are usually sucked up out from a buffer tank, built in a chemical station, by using some centrifugal pumps, specially built for aggressive liquids. For preventing some damages, two pumps for evacuation were provided for every tank, but only one will begin to work in a damage case. The conveyance is generally made through a polyethylene pipe network. The waters resulted from treating the condensation capture filters, because their initial pressure and reduce aggressiveness, were gathered in a local pipe network for worm waters, by OLT type, for example. Aggressive waters, resulted while the HST (Hot Steam Tanks) chemical washing needed an iron pipe conveyance network.

Installation Description

The pipe, which takes over all technological waters was thermo isolated and supplies the neutralizations tanks. These and the remainder of equipment were placed inside a so called neutralization station. Two tanks are foreseen and built and while one is filled, other one is neutralized and emptied. A tank may be 90-95% filled, the measuring of level being made with ultrasonic transducers. Afterwards, a feeding valve will be

Tele: E-mail addresses: vantuldivin@yahoo.com

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closed and the aggressive waters will be homogenized with a centrifugal pump. The liquid is sucked from one meter of bottom side of tank and it is bought back, at one meter from top side. Some PEHD (polyethylene of high density) pipes are used. Inside the tank, the pipe which brings waters back was coupled with two horizontal pipes, mounted in opposite sides, on the vertical walls of tank that is for an efficient homogenization. Two pH transducers will be mounted, one in the top side of a tank, other in the bottom side, so four transducers will be needed on the whole, that is pH regulators. The homogenization is made until the two pH transducers show same value. If 6.5 < pH < 8, the liquid is considered to be neutral and may be poured out. If pH < 6.5, the liquid has acid character, is aggressive and must be neutralized by a base: NaOH. A first rough dosing is made with NaOH, until pH=6, then a final dosing follows until pH is increased up to 6.5. If pH > 8, we have a basic character, that is aggressive and it is neutralized by acid HCL. Similarly, the pH is decreased under 8.5 and, then, under 8. The rough dosing is made with a big flow capacity pump, because either for pH >8.5, or for pH < 6, a big quantity of reactive (basic or acid) is needed. That because the pH dependency curve of reactive volume is approximately a horizontal line, specially for pH<2 and pH>12.5. For 3<pH<10, the mentioned curve approaches more a vertical line. For a final dosing, a small dosing pump is needed for bringing the pH inside the range: $6 \le pH \le 6.5$ and 8<= pH <=8.5. Some pH automation regulators are used for both dosing operations. The reactive NaOH and HCL are each stored

in one consumption tank, cylindrical, by polyethylene, for not being chemical attacked. The both tanks are placed in the neutralization station, everyone having two pumps mounted. The reactive conveyance inside them, is made by PEHD pipes, thermo isolated, traced on the walls of the neutralization station. After dosing and pH neutral touching, the depletion will be made, by preference, in the slag and cinder channel, nearby that it is recommended to be placed the neutralization station. The measured values for liquid level, in the neutralization tanks, in the consumption tanks, containing NaOH and HCL, also pH values, make up analogical inputs. The set point values for big and small flow capacity dosing devices make up analogical outputs for the process automation command. The equipment start and stop commands, the one or another tank selection commands and the signalization of the minimum level in the NaOH and HCL consumption tanks, make logical inputs for automation command. The signaling indicators for equipment power-up, for one or another neutralization tanks selection, the start command for one or another pumps, used for filling these tanks, the tanks depletion command and the power-up command for HCL or NaOH supplying, make up logical outputs for automation command.

		DIGITAL OUTPUTS (IESIRI DIGITALE)	<u>i</u>		
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DIGITAL OUTPUTS		1)=START, STOP;		\$0	
INTRARI DI	GITALE				
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		0		0	
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device				port width	
10	line B1 state	Alo I			
	OFF		line 5 B1 dev		
0		line 1 🚃	STOP1		
		10 L	10 N	line 1	line 4
	line B2 state		line 6	HCI-B1	NaOH
• 0		line 2	B2 dev	STOP5	supplies (cpro) P2
port width	OFF	÷0	STOP2		
0			1 0	¥ O	, 0
		line 3 B1 EMPT	Y (plin)	line 2	line 5
		‡0	line 7	HCI-B2	HCL
			NaOH-B1	EMPTY(GOL)	supplies
		line 4 P2 EMDT	GOL	STOP6	(spre) BI
			- Chinh 210b3	0	0
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The automation command is redundant and needs a PC computer and a microcontroller, of Twido type, for example. Inside the PC there is installed the LABVIEW programming environment, where the program Mintia.vi was created, which communicates with the mentioned inputs and outputs through some data acquisition modules, multiplexed by the I-7520 module, plug in USB PC port. The acquisition modules are of I-7024CR type, containing 4 analogical output channels, with 14 bits resolution, of I-7017F type, containing 8 analogical output channels, with 12 bits resolution and of I-7055 type, with 8 logical inputs and 8 logical outputs, there being slots for more cards of any above types. The Mintia.vi program offers a panel with controls and indicators, among whom being the so called "tanks", which symbolize the neutralization and consumption tanks (HCL and NaOH), which indicate, synchronously with the physic reality, the reminded tanks filling or depletion. The start and stop controls command the equipment power supply and

some virtual LED-s and messages inform permanently the operator about the filling-neutralization-depletion process running. Consequently, the panel is both an operative and a synoptic one. It is created also a simulation program, which works independently of process and of data acquisition modules and which was called Mintia.sim.vi. We specify that only one analogical output transmits the set point value for two dosing fine regulators, which control the HCL or NaOH pumps, but only a pump is selected to be fed and so, only one works. Also, only one neutralization tank is selected. Similarly it is happened for the rough dosing, so only two analogical outputs are needed for all cases. In figure 1 is shown in detail the digital inputs and outputs, where *dev* means to *deplete*.

The automating simulation program using LabView

The detailed logical diagram of the automating simulation program is shown in Figure 2.



Fig. 2: Logical diagram of automating simulation program

The Mintia.sim.vi program, created in the LabVIEW environment, installed in PC, runs as in the Figure 3, where the tank filling and pH measuring are simulated.





We may perceive user interface (panel) in LabVIEW environment, while the Mintia.vi program is running, and we could observe the both neutralization tanks. Only one tank may be selected once and the reactive selection is made only after the pH value, in the bottom side of tank, becomes equal with the top-side value. Next, the HCL or NaOH tank is selected and the neutralization process is made till the pH is brought into 6.5 <= pH,= 8 limits. After that, the tanks will be depleted. In Figure 4 it is shown the neutralization process running snapshot.



Fig. 4: Neutralization process running snapshot Behind the Front Panel there is the Block Diagram. The Figure 5 shows pH channels extracting (B1 or B2, up or down).



Fig.5: pH channels (B1,B2) during the running process snapshot

Also, the basic dosing *while cycle* is well presented in Figure 6. Neutralistion if pH-B1 acid



Fig. 6: The acid dosing while cycle

Conclusion

Simultaneously with the PC and independently, the process driving may be performed with the mentioned microcontroller, the automation becoming redundant. The acquisition modules may be acquired and plug in extended slots, on the master microcontroller card and could be software configured. These are others then those necessary for the LabVIEW Mintia.vi program and so the system redundancy is extended. This automation command is very reliable and may be used anywhere in thermo-centrals for aggressive waters neutralization.

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Biography

Valentin Stelian Casavela – BEng. in Computer and Electrical Engineering (Electronics), Polytechnic Institute of Bucharest, Romania, PhD in Automation and Control, University of Petrosani, Romania.

Since 1990 he joined the University of Petrosani from Romania, as a Teaching Professor for Power Electronics, Electronic Components and Circuits, and Informatics. Also he is working in scientific research, the main contributions having in electronic rectifiers and inverters driven by CNC, as well in Control Systems area.