

Technology Development for Safe Drinking Water

Shashikant Sadistap

Head, Agri. Electronics Group, Central Electronics Engineering Research Institute, Pilani, Rajasthan

E-mail: ssadistap@yahoo.co.in

Abstract : In the present scenario the safe and pure drinking water is the necessity of each individual and becoming a challenging task to provide pure and safe drinking water availability. Water is essential for agriculture, industry and human consumption Researchers spent vast amount of time and resources in developing various methods to develop for how best water can be utilized. Particularly in Punjab, report from Punjab News line Network, Monday, 14 June 2010 confirms the high level of Uranium and other dangerous heavy metals present in water samples mainly from southern Malwa region and is responsible for retarded children,. It is crippling children's brain.

Various techniques are available for making salt water into a safe drinking water Reverse osmosis technique is one of them. CSMCRI, Bhavanagar & CEERI-Central Electronics Engineering Research Institute (Constituent laboratories of CSIR) have come together to develop a CSIR technology for addressing the above problems. The developed embedded system provide the better quality product with the use of advance monitoring and controlling algorithms. The Industrial PC based RO automation system is equipped with high performance data acquisition and control (DAS) card, suitable sensors and opto-isolated I/O controls for continuous monitoring and control. The control algorithms are developed using NI LabVIEW virtual instrument platform can be easily adopted for any high capacity RO plant. Appropriate sensors like temperature, pressure, PH, TDS and turbidity etc. are installed for continuous measurement and data logging will give better quality product and safe operation. The system provides features for set points, to display trend graphs and history graphs apart from controlling the required RO plant operations. Providing safe drinking water is the highest priority for all local and state agencies. Safety of the plant is at risk if it is not monitored. The developed automated controlling system plant will give higher and consistent out put.

Key words: Reverse Osmosis, Automation, Desalination, Virtual Instrument,

INTRODUCTION

In present day scenario water is becoming a rare commodity. The economy of a country is dependent upon the best management of their water resources. Water is essential for agriculture, industry and human consumption. Researchers spent vast amount of time and resources in developing various methods to develop for how best water can be utilized.

More over providing drinking water to the masses has become most important problem for all the countries in the world. Increase in the population and increased industrialization the demand for water is increasing day by day where as the resources of fresh water are drying up. The

scenario is worst in India. It is evident that in India in most parts the ground water is abundant but mostly salty. Particularly in Punjab, report from Punjab News line Network, Monday, 14 June 2010 confirms the high level of Uranium and other dangerous heavy metals present in water samples mainly from southern Malwa region and is responsible for retarded children,. It is crippling children's brain.

This was confirmed by Germany's Microtrace Mineral Lab which revealed that hair samples taken from 80% of the neurologically disabled children, and their drinking water contain high levels of uranium, a radioactive element. Further, lack of attractive remunerative alternative to high-water demanding rice-wheat cropping

system and inefficient rainwater conservation and groundwater recharge is leading to declining water tables. Punjab Govt need to introduce some subsidy based projects to harvest rain water instead of free electricity to farmers and provide new alternating cropping pattern with market for farmers. Various techniques are available for making salt water into a safe drinking water Reverse osmosis technique is one of them. CSMCRI, Bhavanagar & CEERI-Central Electronics Engineering Research Institute (Constituent laboratories of CSIR) have come together to develop a CSIR technology for addressing the above problems and to help the society in getting safe drinking water for their consumption. As a case study this was implemented at CEERI Colony for providing safe drinking water to the residents of the colony

RO PLANT AUTOMATION

RO technology is a well proven technology

regarding removal dissolved salts from the water. The only disadvantage is the high rejection rate. Otherwise this is an affordable technology: Critical part of this technology is the RO membrane and automation. It is evident that automation has its own advantages over the manually operated plants. The same is true for RO plants also.

Automation for RO water purification plant is successfully developed at CEERI, Pilani and is incorporated with the membrane filters developed by CSMCRI which is successfully implemented at CEERI, Pilani and CSMCRI, Bhavnagar. The automation consists of platforms developed using NI LabVIEW, Linux, and Embedded technology. The sensing and actuating parameters controlled using the developed automation such as pH, TDS, and pressure etc. The proportional valve is controlled using the PWM based indigenously developed mechanism at CEERI.

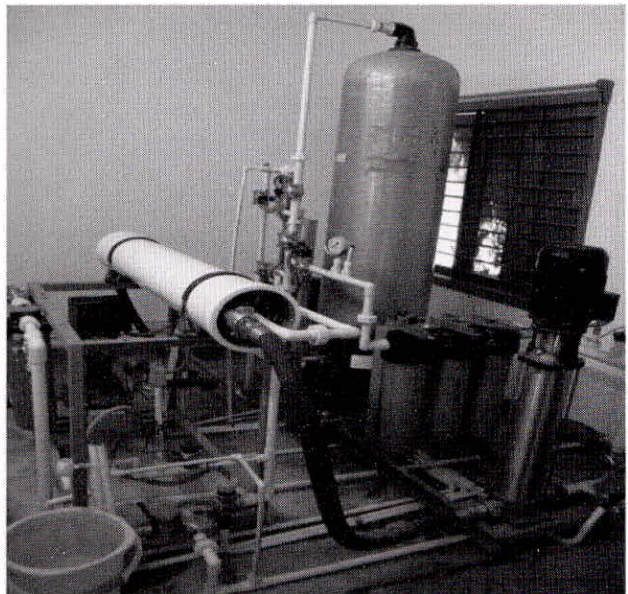
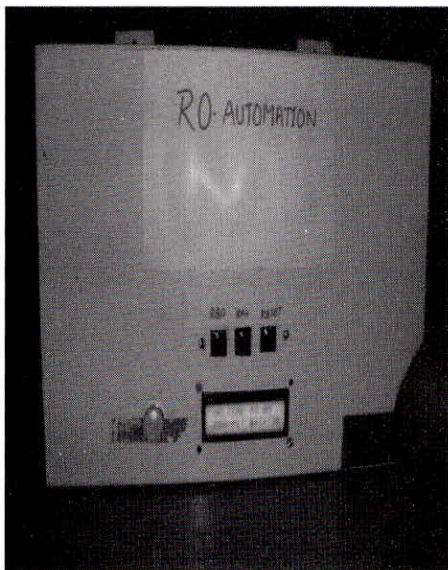


Fig. 1 : RO System field trials at CEERI, Pilani

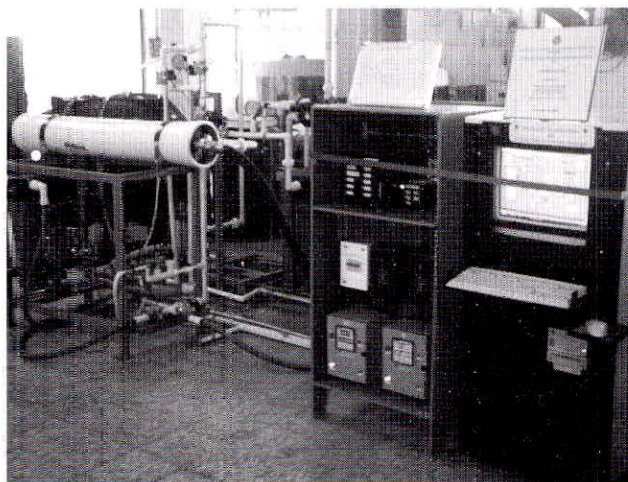


Fig. 2 : RO System field trials at CSMCRI, Bhavanagar

The developed automation using three platforms have their pros and cons, such as LabVIEW programming is easy to implement but costly to develop, Linux supports open source but takes quite longer time for development and embedded technology is cheaper and easy to handle. Our final automation was based on embedded technology and has been successfully demonstrated at CSMCRI, Bhavnagar.

METHODS AND MATERIALS

PIC microcontroller (pic18f452) base control unit and central PC for remote monitoring are used for the control and operation of Reverse Osmosis plant. A serial communication by means of wired RS232 or Zigbee wireless connectivity (IEEE) to the central system is provided to acquire the sensed parameter from the raw (Contaminated) water and product (fresh drinkable) water for analysis and control. Real Time Clock can be set on the control unit itself for date and time keeping function. Data acquisition of water parameters viz., pressure, temp, TDS, PH etc is done by using appropriate sensors with transmitters and connected to the on chip ADC through Programmable gain amplifier (PGA). Data logging

with date and time is performed by storing the data on a non volatile external serial EEPROM connected to the PIC through I2C interface. The software algorithms are written in microchip's MPLAB IDE platform with MCC18 as a language tool. The developed system have self diagnostic feature and alarm generation if critical parameter limit is exceeded Control algorithms for different RO processes modes viz. 1) Back wash 2) Rinse 3) Product water 4) Water wash 5) Chemical wash are developed and tested to maintain the TDS and PH value of the product water within the acceptable limits of drinking water norms.

Salient features of the developed system are

- Operational condition monitoring system for prompt operation and maintenance.
- Decision support system
- Online monitoring of Critical Parameters of water
- Indigenous low cost PC/Embedded technology
- History of TDS and important parameters

- Prediction of cleaning time
- Prediction of Healthiness of membrane
- Automated operation
- Remote monitoring via Internet
- Easy to operate
- Well proven technology installed all over India and Abroad

Monitored Parameters:

- Pressure(4 Points), temperature (2 points), pH (2 points), Total dissolved salts (TDS) (2 points), turbidity , water flow (2 points)

Derived Parameters:

- Rate of removal, rate of scaling, Healthiness of the plant

Controlled Parameters:

- Final Pressure, water flow and TDS

Control signals :

- Analog for controlling pressure, Digital for controlling solenoid valves

RESULT

Proper control and monitoring of the RO plant using low cost high performance embedded system is achieved. The measured RO parameters are compared with standard meters and measurement accuracy is found to be +/- 2% over the range while output TDS, turbidity and PH values are within the acceptable limits.

CONCLUSIONS

Reverse Osmosis is the finest level of filtration available. RO is a membrane process that acts as a molecular filter to remove 95 to 99% of dissolved salts and inorganic molecules. A vital step in a complete water purification process, reverse osmosis or RO, removes ionic, organic and suspended impurities from water following proper conditioning of the raw water supply.

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