

Potential for industrial automation & process control in chemical industry

Although much advancement has taken place in the science and technology of industrial automation and process control, their usage in the Indian speciality and fine chemicals industry have a long way to go.

Increasing energy prices, stringent environmental regulations, need for energy-efficient operations, and increasingly complex nature of chemical process operations have all increased the need for advanced process control (APC) or multivariable control.

Despite clear evidence that it can significantly improve operations as well as profitability in the industry, usage of the industrial automation in the speciality chemicals industry has lagged behind due to lower awareness, biased attitudes, and lack of clear understanding of the return on investments feasible. The fragmented nature of the Indian chemical industry, hurdles in technology transfer (local as well as international), low level of collaboration between academia & industry, and regulatory issues, also stand in the way.

But with more and more good instrumentation and automation engineers, well versed in chemical processing, and the emergence of vendors – domestic and international – focussed on the Indian market, the prospects seem bright.

This was evident during a two-day 'Industrial Automation and Process Control' (Indus APC) Workshop held at the National Chemical Laboratory (NCL), Pune, from June 12-13, 2015. The workshop, sponsored by Fox Solutions, Atlas Copco and Swagelok, clearly highlighted the gaps and pos-

sible steps the chemical industry and industrial automation companies can take to realize the advantages of the automation and process control systems.

The Indus MAGIC programme

In his opening remarks Dr. Vivek Ranade, Deputy Director, NCL, pointed out that Modular, Agile, Intensified and Continuous (MAGIC) processes and plants are being developed at NCL as part of comprehensive solutions for creating and retaining competitive age.

According to him, most plants in India are 'chemistry-centric' rather than 'process-centric,' but the MAGIC programme helps in blending the understanding of chemistry and chemical engineering to enable globally competitive processes. A MAGIC bench-scale facility has already been established at NCL and is available to industry. Several milestones have been achieved by Indus MAGIC in association with industry participants so far – development of intensified tubular reactors, metallic channel reactors, glass-lined channel reactors, etc. and these have been licensed to industry. MAGIC processes like nitration, water treatment, recycle & reuse, wireless sensing & control systems, etc. have also been developed, patented and implemented in industry.

Wireless sensing solutions

Mr. Piyush Desai, Wiseco Systems P. Ltd., presented features of Wi-Fi-based wireless sensing solutions with conventional sensors and actuators, developed with research inputs from CSIR-NCL under the Indus MAGIC programme. These are useful in establishing wireless connectivity between the manufacturing plant and control

DR. AJIT JOSHI

Email: drjoshi9@gmail.com

room, up to a distance of 100-m, while GSM-based wireless sensory modules are used for communication over longer distances.

Wiseco provides hardware and software solutions, along with support for customization and fine-tuning. These systems have wireless encryption for security, support MODBUS communication & calibration of sensors, and can use existing process control software. The data acquisition software provides visualization and analysis of process data, graphs of various parameters against time, and data storage on Cloud, which can be accessed through Android-based mobile phones.

The wireless systems can be used for monitoring and logging parameters in chemical processes, implementing alarm systems, etc. They have been installed for remote monitoring of poultry farms, water treatment plants, in agriculture and in the pharmaceutical industry. They can even be used for energy audits and for preventive maintenance based on continuous data collection and analysis.

Automation in nation building

Mr. Ramani Iyer, Forbes Marshall (Pune), traced the history of automation in industry and reiterated the importance of automation in nation building.

He opined that the next driver for growth and development would come from automation, which will help industry attain higher efficiencies in us-

age of raw materials & energy, higher throughput and better product quality. “Automation and holistic integration can help the chemical industry improve throughput by 20-30%, and reduce energy consumption by 8-10%. Just fine-tuning chemical processes using instrumentation and automation can give 2-4% yield improvement.”

Process control automation and its connectivity to ERP systems will, in his view, improve operational excellence and help the chemical industry grow profitably. “System integration for functional excellence is possible only through automation. Economically advanced countries have implemented automation in various industries to great benefit. Similarly, developing countries like India must take advantage of automation for achieving a productivity boost.”

Appropriate instrumentation and automation, he added, can also help improve safety.

Retrofitting automation into operating plants

According to Mr. Joy Alur, Managing Partner, Fox Solutions, several challenges facing the industry can be resolved or abated using automation. These include:

- Process and human safety;
- Short product lifecycle and time to market;
- Complex processes and controls;
- Enhanced requirement of process data & analysis; and
- Compliance to international norms.

He described how Fox Solutions implemented full automation and process control in a 20-year-old fine chemical plant, which did not have safety systems meeting international standards, had obsolete control systems, excess of manpower, and no direct process reports, historical process

data or interface with IT. The solution, with fail-safe and safety integrated level (SIL) systems having risk mitigation programmes at all steps, was successfully implemented, with main operating & control screens similar to the earlier operating system.

Automation, he added, can help reduce the number of operators, provide easy diagnostics, make available all historical process data, avoid batch losses, make new product additions fast & easy, and achieve integration with available ERP systems.

Standardised solutions for batch processes

In the fine and speciality chemicals industry, batch processes are widely used and typically more than five products are manufactured in the same batch reactor. Multi-purpose plant & equipment, with relatively small capacities are common in the industry, and production is often seasonal or campaign-based with short lifecycles.

According to Mr. Madhav Kane, Consulting Process Control Engineers (Pune), for such processes, the ISA S88 Batch Control Standard is perfect. It is suitable for plant-wide control of batch processes, has flexibility to change products, and covers shared resources. The standard helps obtain consistent and repeatable production, and enables compliance with stringent regulatory standards.

Before the advent of this standard, no universal model existed for batch control, and users had difficulty in communicating process requirements, and integrating & configuring control solutions from different vendors. The standard and consistent terminology available with ISA S88 helps clear communication and is useful right from

the development stage. It has been in use for more than 15 years in industry and can be applied to automatic, semi-automatic, manual and even continuous plants.

Controlling batch processes

Batch processes have several peculiarities: finite, but variable duration of batch run; non-availability of sensors for feedback control; non-linearities in chemical reactions & poorly known reaction mechanisms; and diminishing opportunities of correction as the run progresses.

In chemical industry, there is high rejection of batches and wastage due to contamination. In multi-step batch processes, reduced overall yields are obtained and there are batch-to-batch variations at individual steps. By adopting various technologies for batch optimization, one can design better batch control strategies and achieve better, consistent performance. Multi-variate statistics tools can be used for improved detection and diagnosis from the archived batch processing data. Classification of batches – as best, average and good – based on certain parameters, can facilitate early realization and accurate prediction of quality indices.

According to Dr. Ravindra Gudi, Professor of Chemical Engineering, IIT-Bombay, using automation one can shorten batch release time, minimize batch variability, correct aberrant behaviour, and help in early detection of non-productive batches. It can provide ‘real-time’ quality tracking and assurance by continuously assessing batch health.

Critical path initiative (CPI) and process analytical technologies (PAT) incorporate modern quality principles into regulating manufacturing, and have found wide accep-

tance, especially in the pharmaceutical industry. PAT is a system for designing, analyzing and controlling manufacturing through timely measurements during processing. It emphasizes process understanding and its framework advocates the use of multivariate tools for design, data acquisition & analysis, process analyzers and process control tools. PAT promotes a risk-based and integrated approach and has the ability to evaluate and ensure acceptable quality of in-process and/or final product based on process data. Dr. Gudi discussed the application of advanced control technologies for mid-course correction of batches and for iterative learning control (ILC).

Improving efficiency and productivity through APC

Process control has changed drastically in the last three decades. Digital controllers are now widely used, instead of analogue devices, although DCS control systems still the latter. Digital control has also made it possible to control all units of a large chemical plant, such as a petroleum refinery, from a single control room.

Dr. Dinesh Jaguste, Yokogawa India Ltd., elaborated on the use of APC in which multivariable input-output relationships are mapped, with an example of a xylene column, which separates the *ortho*-, *para*-, and *meta*-xylenes. This is an extremely complex operation carried out at higher pressure. Before application of APC, several PID control loops in the existing automation systems were in manual mode.

Business process automation: Holistic approach needed

Although manufacturing is critical and the core activity of industry, other aspects of business are just as important. In a steady-state environment,

manufacturing and other operations are carried out in a planned manner, without any major disruptions and plans and forecasts are updated regularly. However, in a dynamic or fluid environment, frequent changes occur in supply of raw materials, production & delivery of products, etc. and most actions are reactive and not well planned.

To excel in such an environment, one must be able to deal with unexpected events and manage operations dynamically. In such cases, the entrepreneur has little control on the cost of raw materials and prices of finished products. The manufacturer has control only on the efficiency of the business process, and reduction of cost in any business process directly goes straight to the bottom-line. Therefore, to increase business process efficiency as well as productivity, business process automation is important.

According to Mr. Alok Pandit, Founder-Director, Equinox Software, automation needs to be addressed holistically – across all business processes. The master framework consists of maximization of profitability through plant asset optimization, operational excellence, business excellence, capex excellence, etc.

Automation is often considered an expense or luxury in the speciality chemicals industry, and the approach to automation is not holistic, despite the



Alok Pandit, Founder-Director, Equinox Software

fact that piece-meal automation is not effective and in fact more expensive. There is unavailability of suitable instruments as well as trained manpower for automation, and interestingly, even if automation is implemented, it is not used to its fullest capacity due to general reluctance to change.

According to Mr. Sadanand Kulkarni, Head – Automation, TransTech Projects (Pune), a complete control strategy should be designed in the first phase, even though it may be implemented over a period of time. “It is useful and beneficial in the long run to standardize using branded systems, rather than going for cheap systems. The company should invest in skilled manpower for automation and also drive people to utilize the system as designed to its fullest extent,” he added.



Sadanand Kulkarni, Head-Automation, TransTech Projects Pvt. Ltd.

‘Team approach lacking’

Dr. Yogesh Suryawanshi, NCL, opined that a ‘team approach’ to process control automation is lacking in the Indian fine and speciality chemicals sector. He observed that the level of instrumentation and process control used in the laboratory is not adopted in commercial production.

Commenting on the vendor situation, he noted that large manufacturers dominate the areas of sensors and field instrumentation, while there are more than 2,000 system integrators and contractors. “More expertise exists for machine automation than for chemical process control automation.”