

Process Analytical Technology (PAT) Initiative

Background

Process Analytical Technology (PAT) is defined by the FDA to be "a system for designing, analyzing, and controlling manufacturing through timely measurements (i.e., during processing) of critical quality and performance attributes of raw and in-process materials and processes, with the goal of ensuring final product quality."

By monitoring material properties at each step of the manufacturing process, the manufacturer can better understand and control their process at the most critical points. To achieve this, PAT utilizes a networked system of chemometric analyzers, multivariate data acquisition/analysis tools, databases, and process control tools. Feeding PAT data back to a control system provides further fine tuning of the manufacturing process to improve product quality. Use of the OPC communication standard makes PAT systems capable of interfacing with nearly every automation system on the market today.

Currently PAT is predominantly used in the Pharmaceutical and Chemical industries, however PAT is applicable to practically every process control field where quality and efficiency are critical.

Advantages

The advantages of PAT are incredible. By offering non-destructive on-line analysis of a process, a manufacturer can move further towards the goal of Real Time Release Testing (RTRT). RTRT has long been the holy grail of the pharmaceutical manufacturing industry. Dr. Christine Moore, PhD, Deputy Director for Science and Policy at the FDA Office of New Drug Quality and Assessment states that "from an industry standpoint, RTRT approaches seem to have economic benefits from manufacturing efficiency, such as reduced inventory and lower laboratory costs."

In addition, on-line or at-line PAT sampling (versus traditional off-line grab sampling) allows for an increased sample size. While traditional off-line grab sampling contains enough points to create a statistically significant dataset, a larger data set remains a better representation of the sample population as a whole. This in turn allows for greater quality measurement.

PAT systems have been developed by companies such as Siemens to provide a common platform for interfacing with many analyzer technologies, such as

NMR and NIR spectroscopy. Major analyzer manufacturers such as the Bruker Corporation, Thermo Scientific, Kaiser Optical Systems, and Mettler Toledo are increasingly making efforts to provide standard interfaces to these PAT systems.

Siemens PAT (SIPAT)

Developed by Siemens, an industry leader in the pharmaceutical industry, SIPAT is a PAT platform that provides functionality for all facets of a PAT system: data management, instrument control, model creation, batch integration, control system feedback, and reporting. Specifically, SIPAT is capable of capturing process analytic data directly from many types of chemometric analyzers, as well as reading various process parameters such as temperature or pH. SIPAT can also be used as a means of controlling and calibrating chemometric instruments, and storing the results of a calibration for later reference. Several levels of models can be created using SIPAT: analyzer models, based on data collected from a particular analyzer; unit operation models, based on data from a particular unit (e.g. process data from specific bioreactor); and high level process line models, based on combined data from unit operations along the entire process line, from raw materials to the end product. The high level process line model is unique to SIPAT, and lets the user develop a general process model that is capable of predicting the quality of the end product based on data gathered from unit operations, coupled with statistical analysis of previous and current results.

SIPAT is also capable of monitoring (via OPC) the start or finish of a batch, operation, or phase allowing interface with continuous as well as Batch Management systems. The high level process model can be integrated into a batch system to regulate recipe parameters based on the results of SIPAT methods. SIPAT-predicted quality data can be fed into the control system, which can then use its existing control techniques to further tune the system. The control system can also be designed to use SIPAT data in real time to make product quality decisions facilitating RTRT. All data is stored in a central database, which is available for use with any standard reporting tool.

SIPAT offers full auditing functionality, and is fully compliant with legal regulations and 21CFR11. SIPAT access can be associated either with a user's Windows login information, or with SIPAT's own built user authentication system. SIPAT automatically records all version changes on all PAT objects, such as methods, models, and instrument settings.

The entire PAT system can be controlled via the SIPAT Client, which provides a common interface for each PAT tool. The SIPAT Client provides a seamless user interface for the application of PAT across the entire system. SIPAT client screen can also be embedded into the control system's HMI system using SIPAT Webinterface ActiveX control. Each SIPAT Base Station has the requisite pieces of SIPAT installed that are relevant to that Base Station's particular function, such as Calculations, Database Loggers, OPC communication, or communications to analyzers.

SIPAT does not have to work exclusively with Siemens automation systems such as SIMATIC PCS7. Standard implementation of the OPC communications standard within SIPAT ensures that it is capable of interfacing with almost all automation systems.

Panacea Technologies helps a major Pharmaceutical Company with its Global PAT Initiative

Since 2009, Panacea Technologies Inc. has worked with a major pharmaceutical company on multiple projects to install and expand its global SIPAT system into over 50 collector and base stations, spread out over two distinct production regions worldwide. Their SIPAT system is now one of the largest PAT systems in the world. Panacea has been instrumental in the ongoing successful operation of this system, providing end-to-end services, including planning, specification, design, installation, IQ and OQ validation testing, maintenance, support, and system expansion.

Panacea Technologies Inc. has developed extensive expertise in all facets of the SIPAT system, such as the Microsoft SQL central database configuration, method development and execution, intervention runs, new analyzer integration, report generation, and utilization of chemometric models and calculation tools such as Camo Unscrambler and Umetrics SIMCA.

SIPAT version 4.0 has recently been released, and Panacea assisted the client in upgrading its worldwide systems. The new version features a larger list of supported analyzers, an improved operator interface, and an enhanced set of administrative configuration utilities.

Panacea Technologies helps another major Pharmaceutical Company close the loop on its Process with SIPAT

Panacea is currently leading a project for a tablet manufacturing unit of a leading pharmaceutical company. SIPAT version 4.0 is tightly integrated with the automation system that controls the operation of the tablet manufacturing process. Panacea has designed this SIMATIC PCS7 based integrated control system that uses 5 SIPAT collector stations for at-line measurement of critical process parameters at three different stages of the process i.e. Material Feeding, Blending and Tablet Compression. The SIPAT system measures these parameters and those results are made available to the automation system in real time. The automation system uses this data to make real time process decisions to either accept or reject the material thus achieving RTRT. All SIPAT data is also archived for real time display and trending. The communication between SIPAT and PCS7 for the exchange of data is via a standard OPC connector. A Microsoft SQL Server Reporting Services (mssrs) based reporting system connects with the SIPAT central database to generate reports on data stored within SIPAT.

How Panacea Can Help You

Panacea Technologies Inc.'s expertise in process control and batch processing coupled with its PAT expertise can help your company with PAT and process control projects. Projects we have worked on have been as small as a simple standalone system utilizing a single off-line analyzer with a single base station, or as large as global networked system with a hundreds of on-line analyzers on multiple production lines. PAT data can be fed back into the automation system for enhanced control or can simply be used to monitor the process. PAT data can also be used by the automation system in real time to make product quality decisions.

To discuss how Panacea's expertise in the expanding world of PAT can boost your process's quality and efficiency while lowering costs, please contact us at sales@panaceatech.com to have one of our engineers discuss custom PAT options with you.