Continuous Monitoring for the Millennium

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ABSTRACT

In recent years, the term continuous monitoring has been closely linked with negative issues. However the future of business and business management will depend heavily on timely accurate information. This includes plant process information. This paper shows how intranet systems can and are being developed for manufacturing facilities that provide more reliable information to all levels of management. This type of continuous monitoring allows managers to manage, and engineers to engineer, and yields results in a more cost effective utilization of manpower and resources.

INTRODUCTION

Continuous monitoring has been around for ever, but in recent yeas it has gained a negative reputation. Most of which is a result of the debunked "Enhanced Monitoring Rule", proposed by EPA. But for the duration of this paper, please remove all of those thoughts and read with an open mind. What we are going to do in this paper is take the term continuous monitoring past it's recent definition and show that continuous monitoring is really worthwhile and some thing that all operators, engineers and managers should be striving for. During the course of this paper, we will try to address the following questions:

What is continuous monitoring?

Where would you use continuous monitoring?

Why would you use continuous monitoring?

What are the benefits of continuous monitoring?

At a glance, continuous monitoring comes in three major forms: process, environmental and management. We will start out by providing a brief history of each form.

PROCESS

Continuous process monitoring started very simply with local readouts of temperature and pressure. The use of two pressure readings resulted in a pressure differential which could be used directly (e.g. baghouse pressure drop) or in a calculation of another parameter (e.g. flow, level, etc.). Each of these parameters provided the operator with feedback on how the unit is operating. Engineers found the information extremely useful in trouble-shooting problems and providing a basis for new designs or modifications. Most of this information was recorded by the operator on a log sheet once per hour. As

management realized the benefit of improved control of product quality and improved cost efficiencies, new monitoring equipment was developed to meet specific needs.

It was found that operating costs were reduced on boilers when they utilized oxygen and carbon monoxide monitors on the exhaust stacks. This information was an immediate and direct indication of the unit's efficiency. This allowed the operator to make adjustments to improve the unit's operational efficiency. When this information was fed directly into a controller system, it provided the controller with the necessary information to make an immediate change_ to the parameter needed to keep the unit operating in the most efficient manner. The final result was and continues to be a substantial savings for facilities.

The development of other field hardened process sensors has made dramatic improvements in operational efficiencies for many industries:

Cement	NOx, SO_2, CO_2, O_2
Petro-Chemical	Gas Chromatograph (GC), FTIR
Furnaces	HCl, SO_2, NOx, HF
Pulp & paper	MeSH, MeOH

Most of the monitoring listed above is based on sampling a process effluent stream. In all cases, these processes improved product quality and operational efficiencies, resulting in lower production costs per unit produced.

Over the past few years, several technologies have been developed for monitoring feed streams to improve operations. This allows for a feed forward control scheme that is proactive to changes before they affect the unit versus feed back control which is reactive. There are several combustion operations (boilers, furnaces, etc.) that have successfully installed BTU monitors on waste feed streams to their units. The installations include both gas and liquid feed streams. This monitoring has allowed facilities to operate with a waste fuel or off-gas instead of buying a clean fuel (natural gas, coal, etc.).

The term "Waste Fuels" is used in this paper for streams that are by-products of a process. It has nothing to do with any environmental or regulatory definition. By their nature, waste fuels usually vary in content, but they can provide a great source of energy and/or other resources that would otherwise be wasted. Waste fuels can provide a big economic advantage for combustion operations if they have consistent BTU content. However, if a facility has to live with the swings in the heating value of the "free" fuel, the fuel savings is more than off-set with production loss from lack of steam when the boiler drops load. Continuous monitoring of the feed stream for BTU contact allows the controller to "see" the problem coming and make adjustments to fuel rates in order to maintain the boiler at its desired load. This continuous monitoring maximizes the use of waste fuels (thus reducing clean fuel usage) while still maintaining the steam production required for the rest of the facility.

Although sensor technologies have advanced dramatically in the last ten years. The single largest benefit to improved operations is in the controller market. Process logic controllers (PLC) have advanced significantly. Combine their advancement with that of the personal computer (PC) and you have the most powerful operational, engineering and management system known to date. The PLC/PC system has advanced well beyond distributive control systems (DCS) in the past five years. This is readily apparent when you see major DCS manufacturers entering the PLC market.

Just five years ago DCS technology represented the front line of control capability, but the monster systems are being taken over by the PLC/PC advantages. A PLC/PC system offers many advantages without loss of capability. Some of the advantages are:

- PLC
  - Lower Costs
  - Virtually unlimited IO
  - Modular design
  - More flexible design
  - Advanced math functions
  - Fully networkable
  - Open architecture

- PC
  - Lower workstation costs
  - Familiar environment (Windows ™)
  - Easy replacement (standard PC)
  - Redundant network data collection
  - Open architecture
  - Optimization and custom software easily developed

Over the past five years, the PLC/PC control technologies have been on a development curve that resembles a power function. Advances and new capabilities in both hardware and software are being released several times per year.

ENVIRONMENTAL

The most regulated community is the hazardous waste incineration industry. For that reason, we will use them as examples for this discussion.

Environmental monitoring started very simply with just temperature and pressure. Pressure differential was used to monitor scrubber operation and air flows. Vacuum was used to monitor draft on the units to control fugitive emissions. Temperature was used to monitor furnace operations to ensure that the unit was maintained in good operating condition. The scrubber water was continuously monitored for pH, and stack gases were continuously monitored for oxygen and carbon monoxide.

Besides continuously monitoring and logging these parameters under the requirements of 40 CFR Part 60, the output of these sensors were used by controllers to maintain the unit at maximum production and minimum emissions. The "continuous monitoring" requirements for these facilities is that a data point is taken at least every 15 seconds to calculate a 1 minute average. Some of the continuous monitoring parameters were tied into an automatic waste feed shutoff (AWFSO). This meant that if an AWFSO parameter exceeded its allowable value (high or low), all feeds to the unit are instantaneously shut-off. These monitoring limits are based on the results of actual compliance testing. Needless to say compliance testing for establishing environmental compliance parameters must be designed to push the unit to its limit (or at least simulate it) to allow the maximum flexibility in daily operations.

All of this seems simple with today's technology, but the hazardous waste industry had to do the above in 1985. They were forced to run while the rest of the world was still crawling, based on monitoring requirements. Many of the improved monitoring technologies we see today are a result of the demands placed on the hazardous waste industry. They represented a market that needed to be supplied.

All products and technologies are market driven, because nobody will make a product that cannot be sold (at least not for very long). With increased environmental monitoring demands, new markets are developing and new technologies advancing to supply these markets. Some of the new monitoring technologies include:

- Stack/Effluent Metals
- Stack Organic Speciation
- Particulate Monitoring

With these new monitoring technologies comes a lot of information and opportunities to other processes. Improved information monitoring provides operators, engineers and managers with new opportunities to optimize efficiencies and reduce costs.

MANAGEMENT

When most people think of management monitoring, the following terms come to mind:

- Return on Investment
- Cash to Earnings Ratio
- Direct Manufacturing Cost
- Economic Value Added

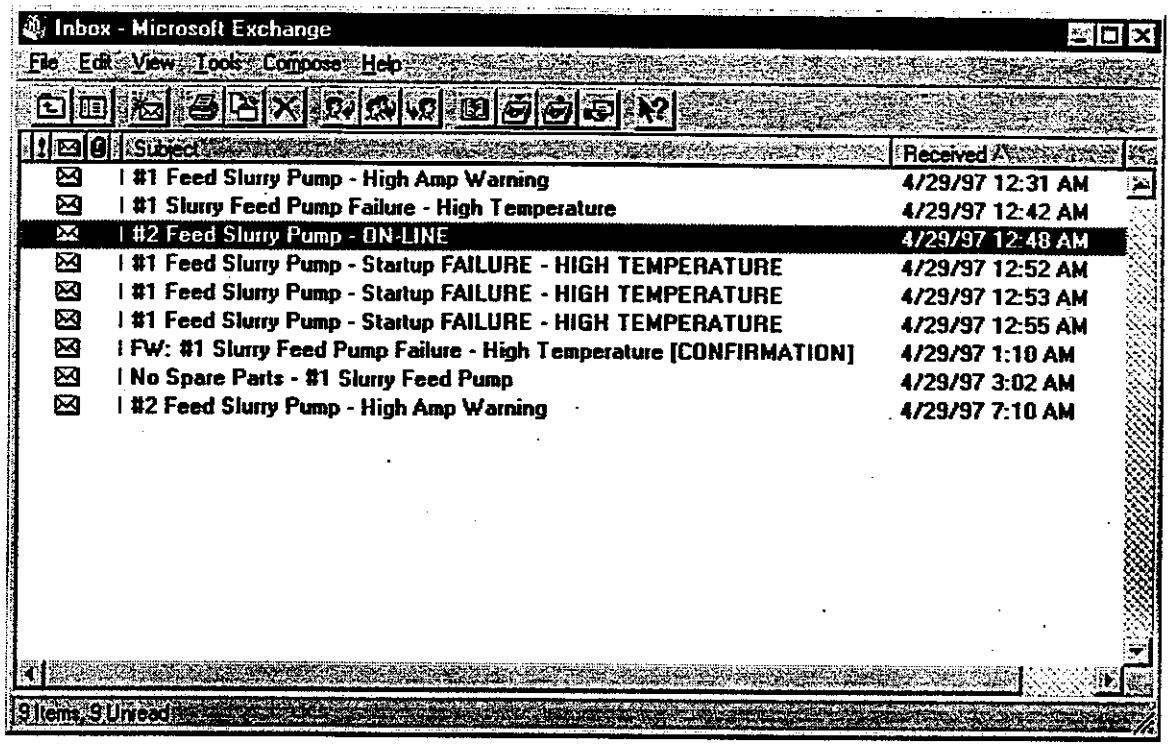
This is old thinking. Today management monitoring goes way beyond basic accounting. It is real-time and interactive. The advancement of the PLC/PC technology, networking, and the explosion of the Internet has provided Management with opportunities that did not exist five years ago.

Yes, the Internet has greatly benefited Management far beyond making airline reservations, looking at the latest regulations or monitoring your latest stock price. The Internet explosion has led to the development of many new software functions and for real-time monitoring over networks. Although you do not want your operational data floating across the Internet, many companies are developing wholly owned, wide area networks (i.e. intranets) within their facilities and companies. This network allows anyone within your domain to view plant operations real-time, query databases for reports, and stay up-to-date with critical events. Today's information management systems (IMS) bring plant data into the front office – real-time. Some people may say that real-time monitoring from the front office is a cute idea, but they do not see the real benefit. The increased efficiencies are real and translate into lower operating costs while the information side allows for quicker, more precise management decisions. The following examples will provide you with a few brief ideas of how an Intranet or information management system (IMS) can benefit your facility.

Examples of Benefits of Information Management Systems

Example #1: A PC communicates with several PLCs across the plant site via the data highway to conduct all production accounting functions at 06:00. The results along with all key details are stored in a network database and a complete report is e-mailed to Accounting , the Production Manager, all the Area Supervisors and anyone else placed on the routing list. A copy is also simultaneously faxed (or e-mailed) to the Corporate office across town or across the country. From this report, a sub-report is generated that provides complete details of all shipment the previous day that is transmitted to the Sales and Shipping Departments. A copy of the report may be published on the facility's intranet where authorized personnel can view the summary or specific details (shipments, quality results, raw material usage, downtime, etc).

Example #2: Before the Maintenance Manager has his first cup of coffee, puts his boots on or even picks up his hardhat, he will know whether he has major problems. His office e-mail has several urgent messages from the "#1 Feed Slurry Pump". The first states that its amp load exceeded normal operation at 00:31. The second states that it tripped out on temperature at 00:42. The third message was from the "#2 Feed Slurry Pump" stating that it was activated at 00:48. The next three messages were from the "#1 Feed Slurry Pump" showing that a startup was attempted, but failed due to high temperature. The next message, at 01:10, was a copy of the second message that had been forwarded to him from the operator confirming that the pump did trip and was taken off-line. At 03:02 the Area Supervisor sent an e-mail stating that he had checked the warehouse inventory via the intranet and found that there were no spare motors available. This might have not been so bad, but as he was pulling his boots on he received a message from the "#2 Feed Slurry Pump" stating that its amp load exceeded normal operation and its temperature was increasing. But he does not have to get anyone on the phone because the operator, Area Production Supervisor, and Area Maintenance Supervisor just got the same information and are already working on it.



The above situation may not seem like much, but this is continuous monitoring for management. Today hours and even minutes can mean the difference between being reactive or proactive. It an also means the difference between shut-down and operating. At thousands of dollars per hour in lost profitability, it does not take but a few hours of lost production to justify the continuous monitoring.

Continuous monitoring systems can provide management with the tools they need to manage into and beyond the millennium. Extremely critical or sensitive events can trigger more than e-mail. An environmental release or catastrophic shutdown can trigger pagers or automated calls at home. The systems can provide continuous health and safety monitoring and control safety shutdowns, or corrective or remedial procedures.

Example #3: One such system installed at a facility allows one operator to monitor what use to take three operators. That was three operators per shift just sitting and watching charts and gauges. A_ continuous monitoring system frees up two operators. At this point manpower can be reduced without a loss in performance. This is due to a greater flexibility gained by the utilization of the monitoring system. The continuous monitoring system also utilizes an IMS, which stores all monitored information on a network SQL Server. This server allows authorized individuals to query the data for engineering and/or management purposes.

This results in more accurate data with more reduced demands on clerical, filing and data compiling. It allows professionals to analyze the data they were hired to analyze instead of reentering the same data over and over.

SUMMARY

We hope this paper provides you with some basic information on IMS capabilities and some of the potential benefits of these systems. It is very difficult to condense a topic of this size into a short paper or 20 minute talk and provide a complete representation of the subject matter. But the most direct analogue of this technology can be summarized in the following statement:

> *The benefits of an IMS or intranet over single loop controllers is about the same as the single loop controllers were over a quarter turn ball valve.*