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WELD DATA MONITORING AS A PRODUCTIVITY AND QUALITY CONTROL TOOL

1. INTRODUCTION:

The costs of shipping defective product are difficult to quantify. However, the risks and costs associated with repairs, loss of customers, or subsequent legal action are potentially huge-they are the main impetus for installing NDT equipment and as a preventive measure - Weld Data Monitoring System in the first place. Similarly Productivity is one of the more simple elements to track with a weld data monitoring solution. It provides obvious insights into the performance of each of the user's weld cells, allowing the company to track such factors as the total number of welds made and total parts welded, percentage of downtime compared to arc-on time, and deposition rates

2. WELD DATA MONITORING AS QUALITY TOOL :

Weld process monitoring is a real time QC/QA method of testing to check for defects or poor quality work, signalling any work that does not meet user defined control limits either arbitrarily defined or by codes, standards or specifications. The beauty of real time monitoring is the availability of information that is captured and summarized for the operator, production and quality personnel. This feedback allows one to define a set of parameters within a tight specification window. However, it is also not enough to simply monitor. A user must collect data and then mine the data when events occur to establish the cause and effect relationship. The cause and effect relationship can then be turned into a QA method to reduce the likelihood of the event occurring again.

Weld process monitoring history also builds traceability so that each part has its own defined weld signature, which can be turned as part of the QA report. Last but not least, the collected information is a valuable source of knowledge that can be used to move new employees up the learning curve much quicker.

In the following section, the basic process for weld process monitoring is mentioned. There are various techniques which have come into the market in the past four to five years. There isn't one system to fit all client needs. In a lot of cases, more than one type of system is ideal since they look for different things. The common thread between these techniques is the underlying principle of a simple visual display for the operator with an intuitive back end monitoring package. The visual display is there for the operator to see and quickly process what is happening and take corrective action.

Offline, the data is mined and analyzed. QA is able to determine that the root cause was by an unstable weld arc causing an intermittent short. This illustrates the importance of real time weld process monitoring and when the tool is used properly, corrective action is quickly applied to remove the disturbance. User defined limits trigger the onset of a disturbance in the weld in real time. The trigger initiates a data capture mode which can then be charted for a better understanding of the issues at hand. A sample distribution curve can quickly allow the personnel to see that the parameters are within the sigma control limits. Figure 1 is showing about ADOR make wireless data logging system in which the weld data is used to co-relate the welding parameters for inspection of welding for its quality.

The strength of most of the applicable systems is the ability to plot weld profile data to weld process data. For example, there is a direct correlation between weld bead height and weld temperature. Therefore monitoring the weld temperature and creating correlation tables to weld bead height yields valuable information for situations when the weld may look good, but the data says otherwise.

2.1 Improving Overall Quality with Advanced Arc Monitoring

Welding quality issues invariably lead to non-value added costs and labour. A good welding information system helps identify the root causes for a number of quality-related issues, and gives the user indications of where to go to solve the problem. Why is this important? Rework is a drag on productivity and the cost of a missed weld or defect rises exponentially the further it gets away from the weld cell without being noticed . The earlier a potential problem is identified, the less it costs to fix.

A properly deployed system will help you answer several critical questions: was the weld within acceptable tolerances for current, voltage, wire feed speed and duration? When a weld is outside acceptable tolerance limits, the system should identify the specific weld in question. Were there enough welds on the component? Has the component been under- or over-welded? Were the welds laid down in the correct sequence? Any deviation from the pre-set ranges will be noted in the program and brought to the attention of the operator and/or the weld supervisor.

2.2 Key Quality Factors Include:

• Missing Welds: The most efficient way to prevent a weld defect from moving downstream is to catch it when it happens. By having an HMI in the weld cell, the system gives the operator a step-by-step sequence to complete the fabrication of a component. The operator simply tells the system when a part is being started and proceeds to make the welds in the prescribed sequence. When finished, the operator tells the system that the part is complete. This method of interaction with the system is done via the HMI or with a specialized welding gun. Once the system receives the input from the welder that the part is complete, the weld count is checked against the expected weld count and desired weld parameters are checked against actual weld parameters.

• Under- and Over-Welding: Under-welding potentially results in welds that that are not up to standards and may fail. Over-welding results in the unnecessary cost of wasted filler metals - for instance, over-welding a 6 mm joint by 2 mm results in 78 percent more filler metal being consumed. Minimum and maximum duration limits are set within the system to identify welds that are longer or shorter than specified. The operator is alerted to these possible errors by the HMI and is able to go into the system, view the weld data, and determine if a repair needs to be made.

• Weld Defects: The system monitors key variables, such as voltage, current, wire feed speed, gas consumption and duration and compares them to predetermined upper and lower limits for each weld. The software then alerts the supervisor to the "failed" welds and he or she can inspect the weld to determine if further action is required.

• Welding in Sequence: Welding engineers direct that a part be welded in a specific sequence for very good reasons: structural integrity, and to control heat input and potential distortion. Since an HMI in the weld cell walks the operator through each part in a step-by-step fashion, there is no ambiguity as to the sequence in which a part should be welded.

3. WELD DATA MONITORING AS PRODUCTIVITY ENHANCING TOOL :

Weld data monitoring - sometimes referred to as arc data monitoring - is not new to the industry. The deliverable in the past was typically raw data. It was up to the user to take that data, interpret it, and convert it into meaningful continuous improvement actions. Many weld data monitoring initiatives failed because piles of data were generated, but the effort needed to convert data to actionable information was too much. The ultimate goal of welding information should be to fuel decision-making designed to increase productivity, improve quality and lower operating costs.

3.1 Gauging Productivity through Production Data

Productivity is one of the more simple elements to track with a weld data monitoring solution. It provides obvious insights into the performance of each of the user's weld cells, allowing the company to track such factors as the total number of welds made and total parts welded, percentage of downtime compared to arc-on time, and deposition rates. Inefficiencies in certain cells are made obvious when each weld cell is compared. This information empowers the welding supervisor to take a closer look at specific cells or stations to determine what the underlying problem may be:

- Is it operator efficiency/capability?
- Is it welded bead defects or problems due to poor joint fit-up or design?
- Is the station waiting for components to weld because of inefficiencies upstream?
- Are there maintenance issues at the cell?
- Is the operator spending too much time grinding spatter?
- Is the operator over-welding?

If the system only monitors production data, all of those factors and questions will have to be determined through observation and manual intervention. Production data helps identify the symptom, but not the underlying problem. When you deploy a system that captures more detailed welding information, simply looking at the data can identify many of these underlying problems.

3.2 Driving Cost Down Through Efficiencies

It goes without saying that welding a part right the first time will increase overall productivity and reduce non-value-added activities such as repair and grinding spatter, but some systems have the ability to go even deeper and measure the impact of continuous improvement efforts. Weld data monitoring is an ideal solution to better understand the true costs of your welding operation, as well as to provide predictive analysis of what changes to the weld process will cost, helping businesses determine the total cost of a change to the process before making it.

These systems provide information on such factors as overall cycle time, arc-on time, wire used, electricity used, gas used and overall equipment effectiveness. Properly presenting this data helps identify problem areas for 80/20 analysis and prioritization, while taking before and after snapshots facilitates the measurement of improvement initiatives and helps justify changes made to the process. Some systems even give the user the ability to track what is happening during non-welding or downtime such as waiting for parts, dealing with poor part fit-up, and secondary processes such as grinding or straightening.

Once implemented, the changes driven by these systems can often lead to lower total weld costs by increasing productivity and using less labour, shielding gas, wire and electricity.

3.3 Training Improved Through Weld Process Monitoring

A system with visual HMIs can dramatically reduce the training curve for new operators since it presents the fabrication process in an easy-to-understand, step-by-step fashion. The HMIs are also valuable to experienced welders, especially when they are asked to fabricate a component for the first time. Ultimately, this allows companies to deploy operators throughout the plant and have confidence that they have everything they need at their fingertips to succeed. Some of the newest embedded welding monitoring systems have the ability to use the HMI at the weld cell to govern the entire fabrication process, even beyond welding. Views can be created that provide instructions on how to load a fixture, reminders to close all clamps, and pertinent safety notices and instructions. The system can even show the operator how to pack the parts for transport to the next workstation. These instructions also do not have to be static slides - video files, audio files, PowerPoint slides, text documents, spreadsheets, PDFs and more can be uploaded to provide an interactive experience.

3.4 Reporting Helps Communicate Performance and Changes

As mentioned earlier, heaps of data are only useful if you can quickly and easily display them in a fashion that helps you come to specific conclusions about your welding operation, creating actionable data. It's also possible that, depending on how many people within your organization have access to the system, certain people will only be interested in certain sets of information - and while the data may make clear sense to the welding supervisor, that same mound of data may be like a foreign language to upper management. With this in mind, some advanced weld data monitoring systems provide preconfigured management reports that bring the desired information to the top for easy viewing and comprehension.

Charts and graphs are presented that make the data easy to understand and communicate. Multiple users can mine the data for critical information on productivity, cost and quality, and different permissions/access can be granted based on authority. Simply select the date range and the type of report you want to view and the system will pull it up for you. Many of these reports can easily be saved as PDFs or exported into other programs for easy sharing.

4.WELD MONITORING SYSTEM :

Database technology has evolved to help bridge the gap between data and information. Welding equipment manufacturers are embedding weld data monitoring capabilities directly into power sources for simplified deployment and management, and are enhancing it with database software solutions that help make that data easier to understand and use. While this is a step forward, it is even more beneficial to implement systems that provide information to not only plant management, but also to operators, welding engineers, maintenance personnel and more. In addition, it is very important that the user select a scalable system that can grow as the company's monitoring needs evolve and more advanced capabilities are required. In this article we'll look at the benefits of this technology and the advanced functionality it provides.

4.1 Background: What Is Weld Data Monitoring?

There are both fully integrated and third-party solutions available on the market today. Systems fully integrated into the power source offer seamless integration and minimal start-up time, while third-party systems are advantageous for established welding power supply fleets without the option of a built-in solution. Ethernet networks are essentially the norm in many manufacturing companies, making it the protocol of choice for getting data out of a welding machine and into a PC program. Welding data from welding machine can also be transmitted by wireless network though RF communication, which is best option for transmitting the data to PCs. The PCs collecting this information can be located at each welding cell or specific areas throughout the building. Because the PCs and welders can all exist on the same network, the ability of many within an organization to access the information is simplified. Weld data monitoring is not limited to automated solutions - it is being implemented in manual welding applications to achieve the same, if not more, benefits.

4.2 There are three primary functions of weld data monitoring:

Real-Time Weld/Arc Monitoring: Measuring defined variables (voltage, current, wire speed, gas flow and duration) and comparing those variables to upper and lower limits, then communicating the results of this comparison.

Weld Data Acquisition: Measuring, displaying and storing defined variables to evaluate specific arc characteristics. In addition to the standard welding parameters (i.e. avg. current, avg voltage, wire feed speed, and gas flow) some systems have the ability to measure parameters such as peak and background values, short circuit frequencies, pulse frequencies, and arc stability.

Production Data: Provides various layers of productivity-related information, including overall equipment effectiveness (OEE), downtime, arc-on time, total parts made, as well as performance factors such as deposition rates, wire use, gas use, and weld faults.

Most systems available on the market today offer at least two of these key functions. While simply monitoring welding output is somewhat useful, the real value of this technology comes when that output is compared to acceptable limits or standards so the user can identify potential process variances. Figure 2 to 4 are examples of weld monitoring system output.

4.3 Typical Weld Monitoring System Consist of Following:

1) Hardware unit connected to welding machine, which acquire weld data from welding machine and transmit this data to central PC thorough certain media like Ethernet cables or RF wireless network.

2) Central unit connected to PC which receives the data transmitted by individual welding machine.

3) Software in the PC store this real time data for individual welding machine and provide analysis, dashboard for monitoring the weld data.

Figure 1: shows the typical weld monitoring system configuration:

Power source with adaptor for wireless communication

Central unit PCB interfacing with PC

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Figure 2: Password protected login and access can be provided for each level of user

Figure 3: Checking the real time working status and welding parameters during welding process.

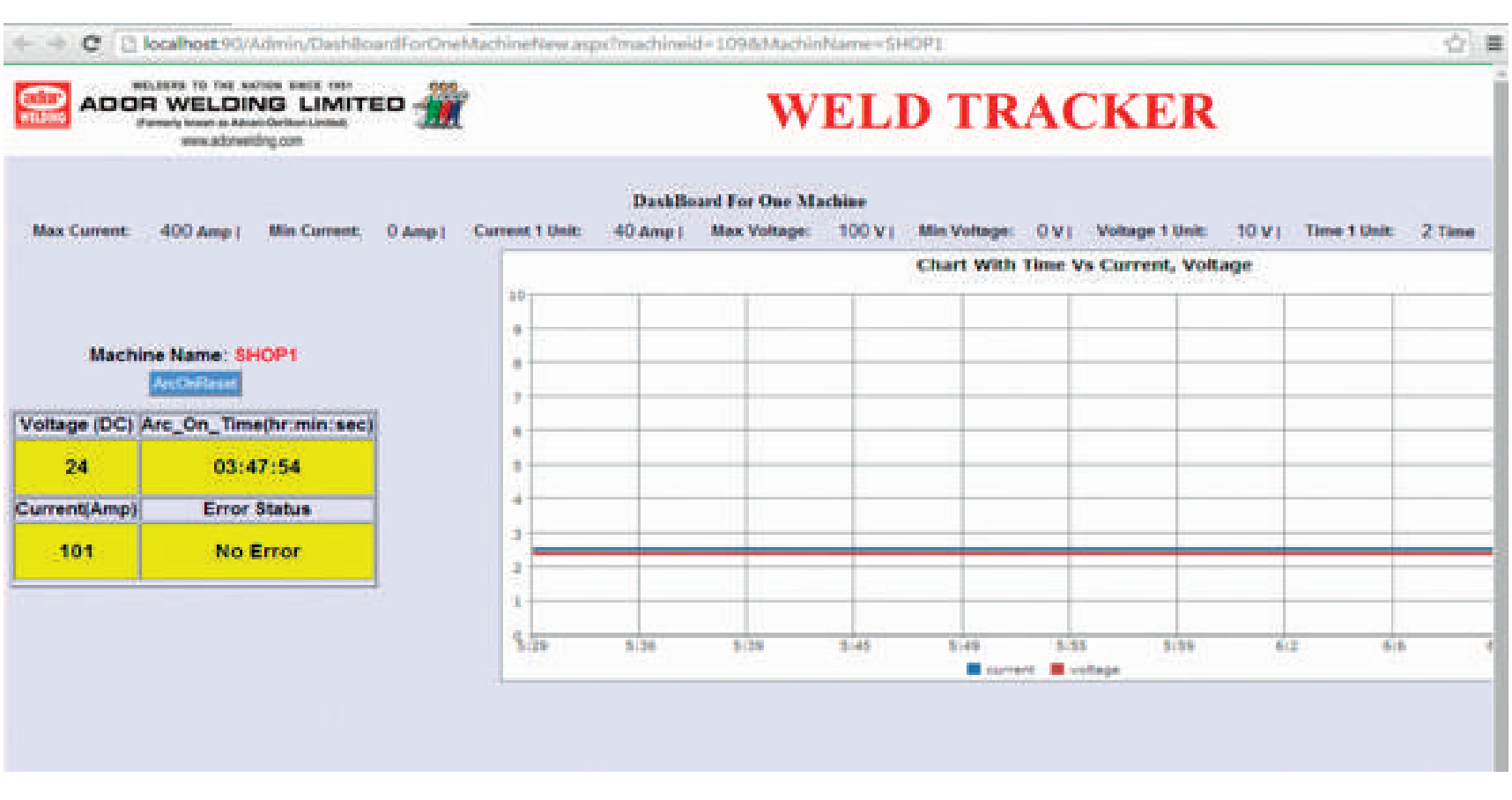

Figure 4: Provides reports on screen or by printing

Report On: 06-09-2014 17:58:09.299	
From Date: 06-09-2014	To Date: 06-09-2014
From Time: 12:54:8 PM	To Time: 5:54:16 PM
Machine Sr. Number: 78-12123451	
Model Name: CHAMP T400	
User's Machine Name: SHOP1	Material Time: Wire
Welding Process: SAW (CC)	Wire Material: Mild Steel
Polarity: DCEP	Wire Diameter (mm): 2.4
Welder Name: Shiva	
Total Arc On Time: 02:00:52 HH:MM:SS	
Average Current: 100.99 Amp	
Average Voltage: 24.05 Vdc	
Total Material Deposition (Kg) : 4.09 Kg	

Parameter Information			
Serial Number	Time Stamp	Current	Voltage
1	06-09-2014 12:55	101	24
2	06-09-2014 13:02	101	24
3	06-09-2014 13:04	101	24
4	06-09-2014 13:08	101	24
5	06-09-2014 13:25	101	24
6	06-09-2014 13:31	101	24.1
7	06-09-2014 13:37	101	24.1
8	06-09-2014 13:43	101	24
9	06-09-2014 13:48	101	24.1
10	06-09-2014 13:50	101	24
11	06-09-2014 14:07	101	24.1
12	06-09-2014 14:09	101	24
13	06-09-2014 14:11	101	24
14	06-09-2014 14:17	101	24
15	06-09-2014 14:36	100	24
16	06-09-2014 14:38	101	24.1
17	06-09-2014 14:42	101	24.1
18	06-09-2014 14:48	101	24.1
19	06-09-2014 14:52	101	24

5. CONCLUSION:

Weld data monitoring is not a silver bullet. While it is a very powerful tool, it still takes work, dedication, and support from everyone in the organization from operators to top management to succeed. It is important to have both a focused plan when implementing such a system and an internal champion who can execute the plan and make sure the company achieves all the benefits of the system. It's also critical to select a system that can grow with you. As users delve deeper and deeper into various production issues, the need for more and different data will become apparent. If your system is not scalable, the quest for continuous improvement may hit a dead end. You will find that weld data monitoring provides many opportunities for continuous improvement and will help you select and determine which initiatives will provide the greatest return in productivity, quality and cost savings in the shortest amount of time.