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You really do not want to fail at failure analysis!

Over the years, many of us have heard of "failure analysis." When you read technical magazines, literature or solicitations you see the words "failure analysis" used often. When something breaks, your boss might say, "We need to perform a failure analysis to see what happened." To many individuals, failure analysis has a broad meaning while to others it has a narrow, precise meaning. The word "failure," according to Webster's dictionary, means "a cessation of proper functioning." "Analysis" means "separation of an intellectual or a substantial whole into its constituent parts for individual study". So what does this have to do with engineering? Well it can mean a lot, because your belief and understanding of failure analysis affects your company's bottom line.

Failure analysis can be used in a broad sense and should not be limited to any one area or discipline. "Root cause failure analysis" narrows the focus for the precise viewpoints of failure analysis.

The other day I was in the hospital emergency room with a family member, and while there, I observed the doctors. All aspects of the problem including blood work, electrocardiograms, X-rays and so on were reviewed. The doctors wanted the best available information to decide how to proceed. They did all the necessary testing to assure that they had encircled the problem. In industry, we need to do the same when it comes to "real" or "root cause" failure analysis.

As I was writing this article, the following example came to mind. It involves a piece of equipment that uses very viscous process material to lubricate the bearings. The equipment failed at the bearing and the shaft broke. Production personnel called in "experts" from various departments to determine the cause of the failure. The metallurgical group performed a failure analysis and determined that the bearing material was wrong. The mechanical group performed a failure analysis and determined the shaft was overstressed and needed to be revised. The process group performed a review of the process and concluded everything was as it should be so it must have been an equipment malfunction. Therefore, better materials were put into the bearing and the shaft was made stronger. The plant started up and, not surprisingly, the pump failed again and the plant was once again shut down.

First of all, not one group performed a true failure analysis. The metallurgical group performed a metallurgical analysis. The mechanical design group performed a mechanical analysis and the process group performed a process analysis. Finally, the group I was in came and evaluated the entire system, including the process history as well as mechanical, instrumentation, control and metallurgical analysis. The group evaluated the work already done, put all the pieces together and determined something was not adding up. The true root cause was faulty instrumentation. A low level in a feed vessel to the pump indicated a higher level some of the time. The pump was cavitating and the product lubrication of the bearings was failing at intermittent intervals. The last group performed a true, or correct, complete failure analysis and the problem was solved.

So what is a proper failure analysis? Failure analysis should be used as a term for a complete multidiscipline engineering assessment to find the "root cause" of a failure of something that is not performing to expectations.

I believe the best approach to failure analysis involves a multidiscipline approach to identify all the physics involved with the problem. A team will typically include, but not be limited to, a process engineer, a mechanical engineer, an electrical/controls engineer and metallurgical engineer.

It is not necessary for each engineer to be fully engaged with the project. It is, however, important that they be in communication and understand what is going on.

In the end, to achieve a good "root cause failure analysis," all aspects of a problem have to be reviewed. Don't let the details bite you. Don't let the lack of a multidiscipline approach let details escape consideration. Make sure a competent professional engineer that is experienced in coordinating a multidiscipline effort is involved in the failure analysis.

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