INSPECTION MANAGEMENT

Preventive Check-Ups

How often should chemical facilities be inspected? Bayer Technology Services helps find the optimal solution on a scale from "too infrequently" to "more often than necessary" – with equal benefits for both safety and productivity.

Although Dr. Michael Renner still feels perfectly healthy, after turning 50 he decided he should see his doctor for a general health check-up at regular intervals. Every aspect of his health is tested, as recommended for his particular age group: intestinal tract, prostate gland, heart, skin, eyes, all sorts of blood values and a lot more. Ten years ago, Renner's visits to the doctor were much shorter and far less frequent. In general, he only went to the medical practice when he had a specific health issue.

Renner knows that it is right and sensible to observe one's body more attentively with increasing age. "Unfortunately, the probability that something may no longer function perfectly is higher," he admits somewhat reluctantly. And he also knows that if something is not functioning properly, it is a good idea to identify the problem as early as possible.

Renner's appreciation for regular check-ups is this big because he also acts much the same way in his own profession – despite the fact that Renner is a materials engineer instead of a medical practitioner. At Bayer Technology Services he is Head of Materials Technology/Mechanical Integrity, and as such, he is obviously not involved with the human body, but instead works with chemical facilities. However, at second glance, the two very different fields have a number of things in common. While one field deals with the strain on joints, blood vessels and organs, in the other it is reactor vessels, pipes and pumps that are subject to stress. Wear, tear and corrosion can affect the materials over the course of time. That is why chemical plants also have to be inspected on a regular basis.

In Germany, for example, the Ordinance on Industrial Safety and Health normally expects plant operators to undertake such inspections every five years. Reactors, tanks and pipes are completely emptied in order to meticulously examine all the components of the plant – also from the inside. The aim is to detect and correct any and all safety risks well before they become an issue. This might be a hairline fracture in a stainless steel container, advanced corrosion in wiring or an imminent valve leak.

Plant expert Renner finds this safety requirement absolutely correct. However, he feels rigid regulations based on time intervals alone are too inflexible. "There are components that one can safely expect to fulfill their task under certain processing conditions longer than five years without any problems," says Renner. "But there are other plant sections, however, which perhaps may even require more frequent checks using a very specific inspection method."

Although many countries still adhere to time-based regulations, a philosophy is on the rise that is completely to his liking: risk-based asset management. This concept bases the frequency of safety checks for plant and equipment on the respective condition and the actual risk analysis. And it implies moving away from the conventional approach of subjecting all facilities to the same rigid inspection cycle.

Having worked himself in the United States for five years, he saw how U.S. refineries initiated the paradigm change as early as in the 1990s. "Instead of just time-based inspection management, people changed to scheduling inspection cycles according to the features specific to the process used in this particular facility and its actually existing risks," Renner explains. "This means, you carefully examine which concrete risks with which probabilities and which hazards actually exist. Only then do you decide on the suitable inspection sched-

The frequency of chemical plant inspections depends on their respective specific risk factors. The same is true for personal health check-ups.

"While rigid time-based inspection intervals are usually established on arbitrary assumptions with little knowledge of the actual condition, the risk-based approach uses analysis results."

Dr. Michael Renner, Bayer Technology Services

ules that meet the requirements of the special risks specific to a particular plant." Applied to the example of medical exams, it is much the same as advising from the age of 45 to have the prostate screening once a year or to say people with fair skin and red hair should be checked for melanoma more often than people with darker skin.

In the meantime, this risk-based approach is limited neither to refineries nor the United States. In fact, it is also increasingly spreading throughout the chemical industry. And Bayer Technology Services is ready to offer support to all those who aim to introduce a more flexible approach to their inspection management. For this task Michael Renner has assembled a team of some 150 employees around the world in the regional Materials Technology/Mechanical Integrity departments.

"They go to our customers, make a very painstaking survey of the processes and the facilities and then calculate a risk matrix," Renner explains. For this review each component of the facility is assessed, for instance, whether it has aged more quickly than expected or experienced a change in its condition, and then the probability of this occurring within a particular period of time is determined. The risk is classified in five different levels, which are expressed in colors from green (low risk) to dark red (high risk) in the matrix. Also included is the risk in the event of possible damage. There is obviously a big difference if acid or hazardous gas were to leak after rust perforation of a manifold rather than just tap water.

When explaining this approach, Renner often mentions the term criticality. It is the criterion for the possibility that a part of the facility or a condition is critical and a risk is to be expected. Dr. Matthias Pfaffelhuber, Head of Competence Center Risk-based Maintenance in Renner's team, prefers the word criticality to risk. "Risk has a negative connotation and sounds as if a specific dangerous event can be anticipated," says Pfaffelhuber. "In our approach, however, we are actually assessing only critical factors and probabilities of events."

The Bayer plant for the production of MDI in Shanghai underwent a particularly efficient inspection.

An Efficient Check

Downtime costs money. In plants that produce several hundred thousand tons a year, every single day of production outage can make a difference of more than one million euros in lost sales. It is therefore all the more important to plan and execute inspections involving downtime as efficiently as possible.

This is exactly what a team from Bayer MaterialScience and Bayer Technology Services succeeded in doing at the turn of the new year in Shanghai. Bayer MaterialScience has been producing MDI, the raw material for polyurethane rigid foam, at the site since 2008 – currently at a capacity of 350,000 tons per year. In accordance with legal provisions, a first comprehensive plant inspection had to take place by 2011. Besides the entire MDI train, this would also have to include production facilities for basic chemicals, raw materials, preliminary and intermediate stages as well as infrastructure operations.

The team also used the plant downtime to conduct further inspections to ensure operational reliability and to execute small investment projects. Because of the optimal planning, more than 1,500 single operations could be performed within a few weeks. Dr. Mathias Benz, Reliability Manager for Bayer MaterialScience at the Shanghai site, was also pleased about the highly successful and efficient check: "We really appreciate the inspection expertise of Bayer Technology Services very much."

“We highly value the expertise of Bayer Technology Services when it comes to plant inspections.”

Dr. Mathias Benz, Bayer MaterialScience

Once the matrix is completed, Renner’s team extrapolates a specific inspection plan for the coming five or even 20 years. “There can be sections of a plant for which we recommend more frequent checks than in the past,” Renner explains. But exactly the opposite can also be true – in other words, less frequent inspections, for instance, every 10 years. Despite the still valid inspection provision of every five years, German authorities are now willing to reconsider if it is clear that longer inspection cycles are sufficient or that carrying out reliable, but less time-consuming non-intrusive inspection methods stand on an equally sound basis as inspections requiring excessive downtime. If necessary, the replacement of plant sections can also be timed.

Some of these alternative checks involve methods that can be implemented while the plant is in operation. Examples are ultrasound or X-ray measurements to control material thicknesses or to detect hairline fractures. Another is baycorroxxion – a measuring system that Michael Renner was instrumental in helping to develop. It records voltage flows with high sensitivity, from which corrosion occurrences can be deduced. “The results of these measurements are computerized directly into our inspection plans for updating where necessary,” says Pfaffelhuber.

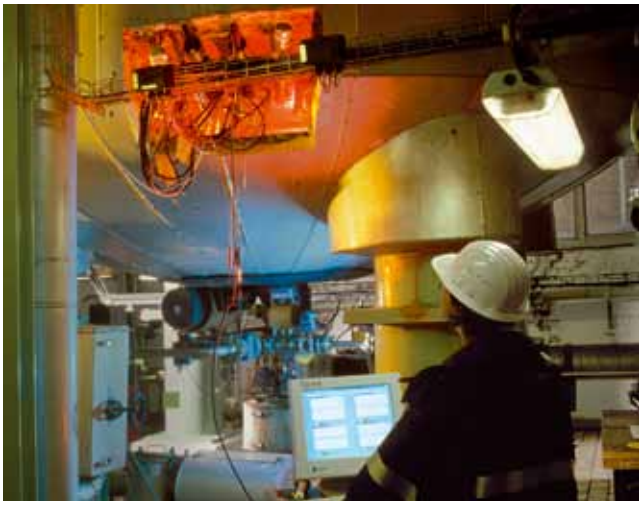
Experience so far shows that on average fewer inspections are sufficient for most facilities than with the conventional, rigid interval-based inspection management system. “There are cases where we could reduce the number of routine inspections by 70 percent,” Renner remarks.

This concept might leave some operation managers with a queasy stomach and sleepless nights, but Renner stresses that having longer intervals between inspections does not mean cutting corners in terms of safety. “While rigid time-based inspection intervals are usually established on very arbitrary assumptions with little knowledge of the actual condition, the risk-based approach uses the specific analysis results.” Pfaffelhuber also points out that unlike the interval-based method, the risk-based approach takes concrete facts into consideration and knowledge supplied from various scientific disciplines.

Renner points out another factor that at first seems paradoxical: “Sometimes more frequent inspections can actually prejudice safety.” This is due to the fact that tanks, pressure vessels and pipes have to be emptied and rinsed for each test. “This can even increase the risk of corrosion.”

The proactive approach also allows certain tasks such as replacing parts or a specific inspection to be combined so that everything can be done in one short downtime. Michael Renner notes that planning optimal plant downtimes so that they are as short as possible is something he and his team can help customers organize.

Shorter downtimes also means higher plant reliability and thus fewer production losses. In one case the assessment by Renner’s staff meant a customer was able to raise facility output by 20 percent. The resulting financial savings from inspections amounted to more than one million euros in five years. For Renner reconciling economic interests and improved process safety is ideal.



Suitable processes such as X-ray measurements (left) or corrosion checks from outside (right) also provide for safety while the plant is in operation.

There is still a lot to do to further promote the idea of the risk-based inspection approach. Michael Renner senses the need by the number of inquiries directed to his team from all over the world. In fact, he is among the few all-round corrosion experts in the world today. In this already elite group, he was elected a NACE Fellow in 2004. The U.S. National Association of Corrosion Engineers gave him this honor in recognition of distinguished contributions in the fields of corrosion and its prevention. Some customers have long chosen their own accolade for him: they like refer to Michael Renner as the “corrosion doctor”!