How Safe Is Your Pollution Solution?

Priority to the control of pollution should never create a serious danger problem, no matter how great the pressure for compliance with pollution regulations

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How safe is your pollution solution? That phrasing may appear somewhat glib and frivolous; however, it is wise to bear in mind the message it delivers. Pollution control is today an essential in the chemical industry, yet it is equally essential that the chemical industry remain safe in carrying out that activity.

The questions that must be answered are these: Was safety of prime consideration when that pollution control project was put together? Or was safety relegated to a back seat in order to meet a compliance date? This article will discuss this problem and cite examples to emphasize the importance of it.

Four points to keep in mind in pollution control work are these:

1. Do not let a compliance date override good judgement with regard to safety. If a safe solution cannot be found in time to meet a compliance date, be very candid with the regulatory agency when asking for relief. If relief is not given, be prepared to use the courts to present your case.
2. Do not experiment in a full-scale operation. Experimentation belongs in the laboratory or within pilot scale.
3. Demand that manufacturers research their equipment with regard to the particular pollutant, or be prepared to do it yourself. Good data are a must.
4. Look ahead to possible plant changes when evaluating the safety of pollution control installations. Document all findings related to safety and make sure that these are prominently noted in your files.

Safety has always been of primary consideration in the ammonia industry. Seventeen technical manuals on the subject have been published following annual meetings. In addition, published committee investigations are available on such specific matters as ammonia storage, storage and handling of ammonium nitrate, and several others.

Compliance regulations aggravated problem

Our industry has always been concerned with pollution and its inherent dangers because of the materials we handle, but it became increasingly important with the formation of the United States Environmental Protection Agency. Publication of guidelines and compliance dates began appearing in the Federal Register and each of the States began working on more stringent laws and regulations governing pollutants. One heard many exclaim, on reading the compliance dates, "It's impossible! It can't be done within that time frame!" only to find a registered letter on their desk one morning stating that a citation was forthcoming. This can be a very upsetting event. Generally, after a hearing, a citation is issued along with a strict compliance schedule.

That strict schedule is the most worrisome matter in regard to safety. It affects our every move and our overall thinking. Was that pollution control project that was installed really safe? Did we give safety the same high priority normally found when making process changes in an operating unit, or were our thoughts of safety obscured by the necessity to meet a time limit, dictated to us, in order to keep our plant gates open? If safety was not properly considered, disaster could be just around the corner.

With pollution control devices, we have been forced to work with unfamiliar equipment and technologies, as well as with familiar equipment but used in a manner we are not familiar with. Pollution control was the prime factor in the design of this equipment and processes. Therefore, most were not properly researched or piloted with regard to safety when used in our industry and with our materials.

A case in point was made in a paper presented at the Vancouver meeting in September, 1973, titled, "Explosion in a Water Treating Unit." In a pollution control program to recycle contaminated water, a continuous ion exchange unit was being used for removal of ammonium and nitrate ions from plant waste water. Regeneration of the cation resin was being accomplished with 4N HNO_3 (22%), and regeneration of the anion resin utilized 4N NH_4NO_3 (7%). Due to an acid leak, the unit was shut down and blocked in. This was the normal operating procedure.

The cation unit contained a mixture of nitric acid, ammonium nitrate, metal nitrates, cation resin, algae, and water. Approximately nine hours after the unit was blocked in, decomposition of the ammonium nitrate and destructive oxidation of the resin occurred. There should have been no danger in confining the resin with 4N acid according to the resin manufacturer.

Following the failure, the manufacturer did state that certain metal ions, such as copper, iron, and manganese, act as catalysts for the degradation of the polymer matrix. The plant had been using copper sulfate for an algae kill in the feed pond. This was a normal procedure for killing algae and how much it contributed to failure is unknown.

If information on the catalytic effect of the metal ions on resin degradation had been furnished to the plant by the manufacturer, the failure might not have happened. Needless to say, changes in operating procedures were initiated, and no further problems have occurred.

Process knowledge needed too

Equipment manufacturers cannot guarantee safety when the equipment is used to remove pollutants unfamiliar to them. We must demand that they conduct the experimental work or we must be prepared to do it ourselves. Pilot work to investigate the safety aspects of the pollution control system is as important as the ability of the system to clean up pollution and as important as meeting the compliance date for the clean up.

Here is a case to illustrate. In the search for a control device to remove sub-micron particulate from the effluent of an ammonium nitrate prilling tower, the regulatory agency strongly suggested that a wet electrostatic precipitator should be investigated and tested.

Even though the use of an electrostatic precipitator with ammonium nitrate was a frightening thought to me, the manufacturer was contacted. They had no experience with removal of ammonium nitrate particulate, but they were sure it would work and work safely.

The dangers were explained to them and the problems that could be encountered with a loss of water or a dry spot were made very plain and clear. After a number of calls and discussions, the manufacturer stated that they were sure of the unit's safety in that service and were going to quote a pilot unit. When the quotation was received, it explained where and how explosion hatches would be installed, the fail-safe electronic instrumentation (how about a power failure?), and ended by stating that these modifications would make the system "virtually explosion proof."

Virtually is not good enough! The manufacturer was offered enough nitrate to test the unit in their plant, but needless to say, the offer was not accepted.

Field personnel of regulatory agencies can be an excellent source of information on new developments in pollution control devices. They see and hear much in their travels and in their contacts with manufacturers and consultants. However, it is wise to remember that these people are not normally familiar with the dangers involved in handling our materials. In one case regulatory personnel seriously suggested the removal of ammonium nitrate particulate by scrubbing with an organic solvent.

In the same vein, many companies have been forced to increase their staffs to handle the extra load of pollution control work. It hasn't always been possible to find people with experience in the specific field, with the result that much pollution control work is being done by someone inexperienced in that particular industry. In such cases, extra care must be excercised to closely check all work on the safety aspects of each project. It is very easy for a good engineer to come up with an excellent solution; but, due to his lack of familiarity with the materials involved, the solution will not be safe.

Smaller companies with very limited staffs have been forced to use consultants and engineering-contracting firms to handle the additional work load imposed by pollution control. Here again, these people, are not familiar with our operations. It is only familiarity with the materials gained through close association, on a day-to-day basis, that can provide the experience necessary to formulate a safe pollution control program.

We must gear our thinking to accept the fact that a portion of our most experienced personnel's time will be devoted to checking each and every variable in a pollution control project, both to see that it will do the job and that it will do the job safely.

Full-scale tests are serious mistakes

Raw ideas for pollution control, or anything else for that matter, are really worthless until properly researched and tested. A full-scale operation is not the place for this test work. It must be done on a pilot scale.

On one occasion, ammonia was introduced into the tail gas stream of a nitric acid plant in an effort to reduce the brown cloud off the stack. Ammonia was also introduced into the vent of the nitric acid storage tank for the same reason.

No noticeable reaction occurred in the tail gas stream, but a loud thump was heard in the nitric acid storage tank. The exact cause was not determined, but the feeling was that the culprit had been ammonium nitrite. This type of experimentation is far too dangerous.

Extended absorption systems are being installed in many nitric acid plants for NO_x removal in the tail gas. Some of these processes which utilize ammonium nitrate, cause ammonium nitrite formation in a section of the tower. We all know, or have heard, that ammonium nitrite can be a very bad actor under certain conditions.

Experimental data on ammonium nitrite are difficult to obtain and somewhat sketchy. Good data are necessary in the evaluation of a pollution control project involving sensitive materials, and if that information is not readily available, we must be prepared to generate it ourselves. The laboratory experimentation costs many dollars and much time, but it could save an entire plant from disaster. In any event, when we know a sensitive material such as ammonium nitrite is present we must be prepared to expend the capital required for additional instrumentation and installed spare equipment to make the system as foolproof and safe as possible.

Some plants utilize the contaminated condensate from their ammonium nitrate plants in the nitric acid absorber. I have heard several reports of finding ammonium nitrate in the acid train when this method of closing the waste water loop is utilized. It does solve a pollution problem, but it could be a possible safety problem.

Another consideration to make when looking at safety in pollution control work is that of process changes that might be made or of possible changes in the end product requirements of the plant.

Will that waste stream from a pollution control device and utilized or disposed of in one manner today be safe if utilized or disposed of in a different manner at a later date? As a case in point, consider a reticulated polymeric foam filter media with the ability to remove sub-micron ammonium nitrate particulate. The removal efficiency, based on extensive pilot tests, was excellent.

Under certain conditions, it was found that the foam would deteriorate and require replacement. When the foam failed, it would slough off and fall into the 55% ammonium nitrate circulating solution used to wash the face of the filter. In a full-scale operation, a side stream would be taken off of the discharge of the circulating pump to maintain the solution concentration at 55%. The side stream would be taken to an evaporator to be concentrated for use in solution production.

Outside laboratory tests made

As part of the program of looking into the safety of this operation, a sample of the foam was sent to an outside laboratory for testing. This was to generate the data regarding how the addition of some of the filter media could affect the sensitivity of the ammonium nitrate when the solution was put through the evaporator. A TFI sensitivity test with PETN pellet booster in a 3 × 24-in. schedule 40 steel pipe, and a confined cook-off or bomb test for thermal decomposition temperature, was run using pure ammonium nitrate and using ammonium nitrate with a maximum of 6% filter media added.

The TFI sensitivity tests showed no detonation with either material and only minor differences in the pipe splits. The confined cook-off tests showed the thermal decomposition temperature of the pure ammonium nitrate to average 450°F and the thermal decomposition temperature of the ammonium nitrate plus filter media to average 296°F. This is a reduction of 156°F. The steam temperature to the evaporator was greater than the 296°F. True, the filter media carried in the solution should not concentrate in one area of the evaporator, but we all know that it can and will happen.

In this case, another system was chosen for removal of the particulate, but if that plant could have used all of the off-stream directly in DA solution production, the system was an excellent choice. The capital costs were lower than comparative systems and operating and maintenance costs looked reasonable.

This case was chosen to show the hazard that can exist when a material is utilized in a different way. Suppose the off-stream could have been used in direct application (DA) solution manufacture and the system were installed? Now at sometime in the future, the plant's product mix changes and since this small off-stream had been used in solution manufacture, it is put through an evaporator.

Catastrophe could be the result. Any time a material will be utilized in a different manner, it must be investigated for safety.

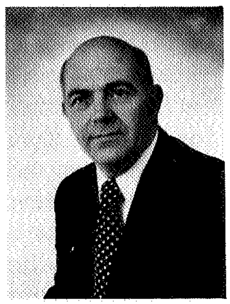
We must evaluate the safety of all pollution control work with possible future plant changes in mind. We do this when looking at other changes in the processes, and pollution control must have the same consideration.

When a hazard could exist if certain changes in the plant were to be made, these facts must be documented and high-lighted in every file covering that project. Perhaps the people that worked on the filter media project in the hypothetical case just discussed had been farsighted enough to investigate and be aware of the dangers in the evaporator. Because this information was not pertinent at that time, it was not documented: we can see the possible result.

Remembering something after the fact is of little solace. I cannot overemphasize the importance of proper documentation of all findings relating to safety when looking at that pollution solution.

Consider the situation where we have not been able to find a safe solution to our pollution control problem and we will not meet the compliance date. This must be reported to our managements; as individuals, we must state that we will put our heads on the block rather than put in an unsafe installation. Hopefully, these are very rare occurrences. But when they do happen, we must be prepared to go to court to plead our case. Documentation of experimental data and our consideration of this data should provide relief.

In recent months, the regulatory agencies have become receptive to listening to problems as long as they are not merely excuses nor based on pure economic considerations. We must show good faith in our dealings with the regulatory agencies; and in most cases, they will show good faith by granting us a variance and additional time to meet compliance requirements. #



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