UNION (34)

HARRINGTON
Industrial Plastics Inc.

July 29, 1996

Mr. Henry W. Scherer, President
International Federation of Professional and Technical Engineers
Local 25
PO Box 2253
Vallejo, CA 94592-0253

Dear Henry,

Thank you for providing me with our transcript and for the compliments you gave me. As you requested, I am returning the transcript you provided with a few minor changes.

If possible, I would very much like a copy of the revised transcript.

Once again, thank you.

Sincerely,

Sean Whitaker

Environmental Engineering Group
14480 YORBA AVENUE • CHINO, CALIFORNIA 91710 • (909) 597-8641 • *FAX (909) 597-9940*

INTERNATIONAL FEDERATION OF
PROFESSIONAL AND TECHNICAL ENGINEERS
LOCAL 25 • BOX 2253 • VALLEJO, CA 94592-0253
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Sean Whitaker

Mr. ~~Shaun Whittaker~~
Technical Representative Harrington Plastics, Inc.
14480 ~~1840~~ Yorba Ave.
Chino, CA 91710

July 26, 1996
Ser. 0435

Dear Sean ~~Shaun~~

Enclosed is a copy of the telephone conversation transcript I have had prepared. I ask that you review it and if you find any substantive and material errors, mark up a copy and mail it so that I receive it prior to August 14, 1996. I do not think there are any errors. This transcript was prepared with great care.

I want to thank you for your information and advice. It is unusual to find a company represented by a person as knowledgable as you are concerning its products, and who is capable of communicating very complex technical information so understandibly and clearly.

Sincerely,

Henry W. Scherer, President
IFPTE Local 25

TELEPHONE CONVERSATION TRANSCRIPT

COMPILED WHILE THE CONVERSATIONS TOOK PLACE

BY

HENRY W. SCHERER

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July 22, 1996

Sean Whitaker

Transcript of three telephone conversations between Henry W. Scherer of IFPTE Local 25 and Mr. Shaun Whittaker, Technical Representative for Harrington Plastics, Inc., manufacturers of air pollution abatement devices, "scrubbers" used in the Mare Island Naval Shipyard metal plating shop ventilation system.

In the following, "S" refers to Scherer, and "W" refers to Whittaker. whitaker

The following conversation was initiated by Henry W. Scherer, President IFPTE Local 25 to obtain information pertinent to operation and maintenance of the metal plating shop scrubbers as specified by the manufacturer.

S: May I speak to the technical representative please.

W: Good afternoon this is Shaun.

S: Shaun, I'm calling from Mare Island. Some of your scrubbers were used in the Mare Island plating shop before it was decommissioned and I am doing a study of their operation and maintenance. I would appreciate it if you could answer some questions for me concerning these things. It appears as if the shop operated the scrubbers incorrectly and did not run water through them all of the time, but thought of them as self cleaning filters and so when the filters would become clogged, would run water to clean the filters and then would shut off the water.

W: Okay.

S: The situation is that this is an improper way to operate these pieces of equipment, is that correct?

W: Yes.

S: What would the long term results of this sort of operation be, have you ever run across this sort of situation before?

W: The scrubber has packing in it, not filter pads.

S: Yes. I understand the scrubbers contain packing not filters. Packing is small rings, balls or other solid shapes whose purpose is to provide surface area.

W: The long term problem of this type of operation...first of all the pumps are supposed to run all of the time to remove whatever is there that is to be removed from the air stream. That's the first problem. Other than that, if the purpose of the scrubber was to remove any type of salt, such as sodium cyanide, the problem is that the salt would build up in the scrubber packing and it would begin to crystallize. This will happen with any salt such as sodium cyanide or any other "sodium" ~~salt~~ type chemical.

S: Okay.

W: The material contained in the air flow would collect on the packing and would not be washed off. It would begin to build up.

S: Would the build up of solids eventually clog up the packing so that no air could pass through it?

W: It would not likely reach a point of complete shut off, but the air flow would decrease progressively until the amount of air flow would be so small that the system would appear not to be working.

W: We had an experience with a company who did something similar. They did not want to undergo the water expense and did not add anything but makeup water, the minerals from the water built up on the packing; eventually the unit went dry. The salt built up and up and they had to go in with jackhammers to get the packing out. it was nothing more than one giant crystal ball.

S: I can understand that. Let's suppose we had a scrubber taking in air from a process giving off sodium cyanide mist. Even though there was crystallization of this in the packing, would there be a significant release of the material?

W: It depends. The packing is what does the removal of the mist. If you are starting with clean packing, as an example, if the mist particles are five microns or larger in diameter they will be entrained on the packing. Particles smaller than five microns in diameter will go through the packing regardless of whether or not the water is on. However, if the scrubber water supply is shut off, the evaporation of the water from the droplets on the packing will cause the salt to be retained on the packing as a film of salt. Once a film of salt has built up on the packing it becomes less efficient and more material passes through the scrubber. The point is that the water spray in the scrubber is to rinse the packing clean. It is the packing that does the filtering, and if it is not rinsed, the stuff it is filtering will build up on it rapidly.

S: So, shortly after the water is shut off, the packing will become coated with a film of solid sodium cyanide, and once this happens, the scrubber is essentially not filtering anything anymore?

W: Correct.

S: I want to bring up the use of these scrubber units for chrome plating. One night there was a massive spill of chromic acid out of the top of the chrome scrubbers. Can you give me any insight into how such a thing might occur?

W: A massive spill out of the top of the scrubbers?

S: Yes, the material came out as a dense mist which actually wet the side of adjacent buildings. Do you know of any mechanism by which this could happen?

W: I take it this is a vertical scrubber?

S: Yes, the plans show the orientation is vertical. The discharge was out the top of the unit.

W: Was there a fan on the top?

S: Yes.

W: Suddenly water gushed out the top?

S: Yes, but it was chromic acid, not water.

W: Did the problem fix itself?

S: I don't know. I don't think so. People on the scene didn't act as if they knew what was happening or as if they knew what to do. I know there was a lot of material that was sprayed out. It appeared to be concentrated chromic acid.

W: Well, first of all that scrubber is not a chromic acid scrubber. It won't remove chromic acid. The droplet size generated by chrome plating is much smaller than five microns in diameter. A vertical scrubber is not a chrome scrubber.

S: Yes.

Delete

W: ~~First of all,~~ that was a poor application of a scrubber.

S: I can see that.

W: I can see why the top of that roof would wind up with chromic acid all over it. If somebody had done that during the day you probably would have seen a nice chromic acid plume. I would guess that once they saw the chromic acid coming out of the scrubber they would ~~stopped~~ the process generating the chromic acid mist or shut off the air line leading to the scrubber. The scrubber won't scrub chromic acid. If they got big drops of water, I would say the mist eliminator in the scrubber broke.

S: That is what I thought too. Would the chromic acid have eaten out the mist separators?

W: No. They are made of polypropylene, and this is not attacked by chromic acid.

S: So it looks like the mist eliminators just broke.

W: Yes, this does happen occasionally, but ~~The~~ scrubbers used for your chrome operation were not appropriate. The mist droplet size generated by chromic acid is on the order of one to three microns in diameter.

W: The packed bed scrubber is only efficient with droplets of five microns and larger, so most of the chromic acid mist just passed through the scrubber?

W: We do make a scrubber specifically for chromic acid. It is horizontal and uses mesh pads rather than packing to condense the chromic acid mist. It is horizontal so that each element of mesh padding can drain. If the scrubber was horizontal, the chromic acid would just drain downward into the next mesh pad and would impede removal of the droplets. The problem is the small size of the chromic acid mist. It is too small in diameter to be removed by a conventional scrubber, and just passes through. We call the scrubbers we make for chromic acid chromium removers. They are given the designation the HCR series.

Vertical

S: Yes, we had a professional company come in and do a very calibrated test which measured the amount of chromic acid entering and then removing the chrome acid scrubbers. The efficiency was determined to be about nine percent.

W: Yes, this is about what you could expect from the use of the vertical scrubber with normal packing to scrub a chromic acid system.

S: What about stack height off the top of a scrubber?

W: We do not engineer stacks. If a plan calls for a ten foot discharge stack, this is what we build for the customer.

S: You are just concerned with what goes on inside the scrubber box?

W: Yes, this is what we design and engineer.

S: Is it possible that if the chromic acid scrubbers were operated like the cyanide scrubbers, and the water was turned on only when the operators thought the filter pads were clogged, a build up of chromic acid crystals would build up to the point where the packing was so clogged that water would not flow through it, would build up and fill the top part of the scrubber and then exit as mist when it hit the fan blades?

W: Yes, however, if there was a build up of crystals on the mist separator plates they would no longer remove the mist and it would pass through the scrubber. Just like the cyanide scrubbers, once the packing is coated, it will not absorb.

--- SECOND CONVERSATION---

S: To move onto another topic. What is the response of the scrubber to a decrease in water flow below the recommended minimum flow? Does filtration efficiency drop off suddenly at a certain point, or is the decrease in filtration efficiency proportional and gradual?

W: It depends upon the chemical of concern.

S: Say it is sodium cyanide.

W: Well, first of all absorption of cyanide requires caustic injection. This means simply, that a base such as sodium hydroxide must be added to the scrubber water to make it basic. It cannot be scrubbed with just water. You must have pH control. Without it the scrubber will not work.

S: If you didn't have pH control there was no scrubbing?

W: Not if you are trying to scrub cyanide.

S: I'm confused.

W: Well, there are two forms of cyanide to worry about. There is sodium cyanide. This is a solid chemical. It is dissolved into water to make various plating solutions. If sodium cyanide comes into contact with acid, hydrogen cyanide gas will be generated. This is extremely toxic. It is death gas. Hydrogen cyanide is a gas and will not be removed from the scrubber unless the water is pH controlled to be made basic. You get hydrogen cyanide generated when a scrubber is drawing a suction off of an acid tank and a cyanide tank. They will react in the air stream and will form hydrogen cyanide before the scrubber. The hydrogen cyanide will not be removed if water alone is in the scrubber. The mist droplets which reach the scrubber, and still contain some dissolved sodium cyanide, will be removed if their size is greater than or equal to five microns in diameter.

S: I see. Is hydrogen cyanide always present.

W: Where there is sodium cyanide and acid there will always be some hydrogen cyanide. It must be accounted for in the design of the particular scrubber system. pH control is necessary to remove the hydrogen cyanide gas. Water will not remove it. ← period added

S: So, this is a very important variable which must be taken into account. One must have a good ideal of the amount of cyanide and acid which will be in the air lines to the scrubber. One must also maintain the water at a basic pH to remove the hydrogen cyanide.

- idea

S: Is it possible without pH control to have so much acid entering the scrubber that most of the sodium cyanide is converted to hydrogen cyanide before it reaches the scrubber?

W: This can happen under the right conditions. It all depends upon what is in the tanks that are connected to a particular scrubber and other conditions. It is important to realize that gas acids such as hydrogen chloride are absorbed into the water mist. Once they are absorbed they will react with the sodium cyanide in the mist droplets to form the gas hydrogen cyanide. Hydrogen cyanide moves out of the water droplets and into the air. The hydrogen cyanide will stay in the air stream unless it is absorbed into water which has basic pH. The Hydrogen cyanide moves right through the scrubber and is not absorbed if the water is not pH controlled to be basic. Having a pH controller takes care of all variables. A pH controller makes sure the water in the scrubber is always basic.

S: What about the sodium cyanide. If the water is turned off will it still be absorbed in the scrubber.

W: You miss the point. The droplets of mist are not absorbed in the scrubber. They impact on the packing surfaces, agglomerate together into larger drops and then are washed off the packing by the water flow from the pump. Mist droplets larger than or equal to five microns in diameter will impact on the packing with a 99.9 percent efficiency and be removed. If the water is turned off they will still impact on the packing surface, but they will not be washed off and will evaporate. The evaporated solid chemicals will coat the packing.

S: So, once the water is turned off the packing begins to crystallize and rock up.

W: Yes. They were right in that turning off the water would not affect the ability of the scrubber to remove the sodium cyanide or chromic acid droplets initially. However, once this is done the packing would begin to crystallize, and once this has proceeded some way, the scrubber would no longer absorb many particles. These would pass through the scrubber unhindered. The size of particle absorbed would go up considerably. The removal process would be much less efficient.

S: By this you mean it would take a larger size particle to be removed by the scrubber?

W: Yes. I cannot say how much, but the particles would have to be much larger than five microns to be captured and removed from the air stream.

S: So, once the packing got coated it wouldn't pick up the Sodium cyanide any more.

W: It would drastically loose efficiency.

S: There were many complaints of the air lines to the cyanide and other process tanks loosing suction. This would be caused by the restriction resulting from the build up of cyanide salt on the packing.

W: Yes.

---THIRD CONVERSATION---

S: I would like to discuss water flow through the scrubbers. Is it intended by the manufacturer that each scrubber should have its own circulation pump?

W: Not exactly. You need enough pumping capacity to provide the proper flowrate and the proper pressure to overcome piping flow restrictions.

S: Suppose there were multiple scrubbers hooked together, with each scrubber being fed from the same pump?

W: There is no problem with this conceptually. Generally, It would be very difficult to get one pump to provide enough flow and enough pressure. What was the required flow rate for your scrubbers? I think you would have a hard time finding a pump that would provide the required flow at the required pressure.

S: 136 gallons per minute.

W: How big a pump and how many scrubbers?

S: Ten horsepower and four scrubbers.

W: A ten horsepower pump would not provide the required flow at the required pressure. You see the sprayers in the scrubber require 60 feet of head. A ten horsepower pump might provide the amount of flow if all it had to do was pump water without any flow restriction. It all has to do with the piping system. Friction in the piping will cause pressure loss. Height differences between the outlet of the pump and the scrubber will cause pressure loss. The pump must expend energy to overcome flow and height difference losses, and this lowers the pump capacity. Any particular pump will be capable of pumping a lot of water with no restriction, but less with more restriction. I do not see how a ten horsepower pump could provide enough power to serve four scrubbers simultaneously. This is not how we do it normally.

S: What is the normal recommendation of the manufacturer?

W: We recommend that each scrubber be served by two pumps. One to provide flow and the other to provide backup in the event of a failure of the normal pump. In this way you are always assured of protection. Even if you would have a remote tank we would recommend one pump per scrubber with one backup pump per scrubber.

S: I see.

W: We think it is not a good idea to use one pump for multiple scrubbers since if your single pump fails you loose all of your scrubbers. This is not a good idea. Most scrubbers we sell today have what we call a one plus one configuration. This is where you have two identical pumps wired so that if one fails the other starts up immediately. This is industry standard now.

S: I can see that this is the way to obtain reliability.

W: How old were your scrubbers? What time period are we talking about?

S: Somewhere between 1984 and 1987.

W: We would have recommended the one plus one configuration then.

S: It seems to me what we had was a local contractor who was working to a contract amount which confined the expense and who did all of the engineering specifications, but no one talked to you.

W: It would appear that way.

S: I haven't been able to find any records that anyone talked to you then. For all I know I am the first. I am just trying to find out how things went wrong.

W: Back in the early eighties the situation was simply that no matter what you wanted to filter from the air, be it volatile organic solvents, cyanide or chrome, all you had to do is put a scrubber on it and it would be okay. This was generally accepted until 1985 or 1986 when people started to ask themselves just how good are these things actually working. Then by 1989 there were much stricter rules in force.

S: Sometime in 1987 or 1988 Mare Island had a company come in and do a formal controlled study of the chrome scrubbers. This was due to the force of impending legislation and regulation. Everyone was amazed to find the removal efficiency of the chrome scrubbers was about nine percent.

S: So, at the very least we should have had eight pumps?

W: That is the recommended configuration.

S: There were reported problems of the scrubbers backing up and water discharging into the ventilation ducts. Can you see how this could occur?

W: There are a variety of ways it could occur. If you have a pump box next to the scrubber sump, a condition can occur where the level in the scrubber will rise due to air pressure in the scrubber box.

S: The Mare Island installation did not have pumps at the scrubber.

W: Really? We intend the scrubber sump to serve as the sump for each pump. We assume, unless it is specified otherwise, that the pump will draw a suction on the scrubber sump. What did Mare Island do?

S: All four scrubbers drained through connecting gravity drain piping to a common tank. A single pump drawing a suction on this tank provided flow to all four scrubbers. Do you suppose restrictions in the drain line would cause a back up in the scrubber? Could this be something as simple as a clogged drain line?

W: This is a strange system configuration. Normally, we assume the scrubber sump which is built into the scrubber body will be used. The Mare Island set up is what we call a remote sump. We assume that the pump will draw its suction directly on the scrubber sump. So the scrubbers did not have individual pumps on themselves?

S: No. They had a single ten horsepower pump. All the drains were connected. All four cyanide scrubbers drained to one tank, and both chrome scrubbers drained to another.

W: How was level controlled in these scrubbers?

S: There was no level control. The problem was overflowing, so it appears there was no level control.

W: With a remote sump configuration the normal system is to have a six inch diameter drain in the scrubber sump so that all the water drains quickly back to the remote sump. You know, with the remote sump configuration, all you really have is a box of ~~rocks~~ packing. That's all a scrubber really is.

S: I don't think we used a six inch drain. I think we used a one to two inch drain. Maybe even three inches. I don't have the plans with me and I am not sure, but I do know they were not larger than three inches in diameter.

W: That would definitely be too small to drain 136 gallons per minute. You need a six inch drain for a remote sump type setup. There is no way a one or two inch drain line will drain 136 gallons per minute. This could definitely be a problem. However, we custom build all scrubbers and draw the plans. These are submitted to the customer for approval. Once the plans come back stamped approved, we build and ship the scrubbers.

S: My reading of the plans is that they were provided to you by a local contractor who specified all dimensions.

W: In that case we would build per plan. If the plan indicated to us that there would be a problem, we would contact the contractor and make sure this is what is really wanted.

S: These plans do not make any mention of the set up for draining or that they are to be ganged together with one pump. They merely specify the scrubber dimensions and hole sizes.

W: In that case we build to plan. We draw the scrubber plans and submit them to the customer for approval. If the plans come back stamped approved, we build to those plans. If we are not told that a remote sump is intended, we cannot design for it and assume the normal configuration will be used.

S: So, with four scrubbers being served by a single ten horsepower pump, they were likely starved of water. It doesn't seem to me that you could tell what the flow rate was to any particular scrubber without having an extremely detailed piping diagram.

W: That is correct. You would need to do some very detailed piping flow calculations. It could be the result would be anything. You could have one scrubber getting full flow and the others getting nothing, each getting the same amount, but less than required. Anything is possible with that sort of set up.

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S: One and two inch drain lines won't do the job?

W: That is correct.

S: So, the overflow problem could be a clogged drain or too small a drain?

W: Yes. When the pump is connected directly to the scrubber sump, and there is a high suction vacuum, there is another cause, but this is not applicable to the remote sump type setup at Mare Island.

S: I see. I want to discuss the matter of providing a filtered push ventilation system.

W: What do you mean by this?

S: The Mare Island environment was very industrial. There were many large facilities doing metal fabrication, grinding and other dust producing work. This dust was everywhere.

S: I have read some texts that say dust can be a real problem with scrubbers, and that in such a case it is necessary to provide a ventilation system that provides filtered air into the shop to make up for the air removed by the suction system leading to the scrubbers.

W: Yes. Dust can cause loading and clogging of the packing. Its like mud, and can stick and clog the packing. If you have a high dust level, like 10 grams per second, you can run into very severe clogging problems. The scrubbers are very efficient filters. Filtration depends upon particle size. A scrubber will clean all particles out of the air which are five microns or larger in size with 99.9 percent efficiency. This includes dust.

S: I want to thank you for allowing me to use up a lot of your valuable time. I also want you to know I am going to prepare a transcript of this conversation. I want to send you a copy. What is the correct name and address?

14480

W: I want a copy. Please send it to Sean Whitaker, Harrington Plastics, 1480 Yorba Ave., Chino. CA 91710

S: I will send you a copy. I think you solved most of my questions. I want to conclude by observing that there were a lot of problems with the plating shop ventilation system which went on for a long time. It seems to me that many of these problems could have been solved by calling you. However, after having spent the money and done the work, it is clear the advice would have required them to scrap a lot of what had been done.

W: Yes.

S: Thank you.

W: Anytime.