Monsanto

FROM (NAME & LOCATION) W. L. Smull - W. G. Krummrich Plant

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SUBJECT 3M INCINERATOR

REFERENCE

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On November 4, Bob Kountz, Steve Webb, Don Bolliger and I visited 3M in Minneapolis to review their experience with a rotary kiln chemical waste incinerator. 3M initially operated their own landfill, but became concerned about ground water contamination from the site. They first moved to a contract landfill for which they provided approximately 60% of the volume and in the late 1960's became concerned about both the financial and environmental viability of this vendor.

They contacted Dow as a consultant in late 1968 for preparation of a feasibility report which was prepared at a dollar cost of approximately $10,000-$15,000 and indicated that an adequate incinerator facility would cost approximately $2.8 M capital and have an operating cost of approximately $32 M per month. At this point in time Dow had not formed the Hydroscience subsidiary.

In April, 1969 they entered into a contract for an incineration facility with Dow on a fixed fee plus a consulting fee basis. Working out the legal details required about 3 months and Dow's firm insistance on the use of International Incinerator as the prime vendor created some concerns within 3M. They prepared a 500 gallon drum load of material that was representative of what they expected to burn and ran a test burn at Dow's incinerator. 3M strongly recommends a test burn for anyone entering into an incinerator project and noted it was particularly helpful in defining potential problems with non-uniform burn rates and the response of the incinerator to this non-uniformity. Their design originally anticipated a ratio of 4 parts liquid wastes to 1 part solid wastes. Due to elimination of liquid waste streams their current experience is an incinerator loading of 15 M lbs./yr. of liquids and 13 M lbs./yr. of solids. In addition they found that bulk handling, as opposed to their design intent of drum handling of liquids, despite their wide scattering of waste producing locations, is the preferred alternate and they are moving in that direction. In their dealings with Dow they provided Dow the information on the volume and characteristics of waste streams to be burned and did not allow Dow to become involved in the analysis of specific waste production sites.

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In October, 1969 through April, 1970 detailed design of the incinerator was done with Dow handling the incinerator, tank farm and air pollution systems and 3M handling the building and services to the facility. The unit was started up in July, 1971 with final capital cost, including services, of $4.6 M. The incinerator has a rated capacity of 90 M BTU/hr. Their design operating cost was $10/drum of material incinerated, initial operating cost was $13/drum and current costs are in the range of $18-$20/drum.

They found Dow was excellent in the area of cooperation and maintaining time schedules, although they expressed a moderate degree of concern about their technical expertise in the area of pollution control device design. The incinerator currently uses 1250 gpm of water on a once-through basis and they are looking at a water recycle/reuse program. They are also concerned about the energy consumption of their induced draft fan which runs wide open at all times with the air flow controlled by variable orifice venturi.

Other things they would do differently for a new facility is to look more sharply at elimination or recycle of waste streams. This is borne out by the fact that their unit has a 35 M lb./yr. design capacity and their current loading is 28 M lbs./yr., as well as the sharp drop in liquid/solids ratio.

The material handling facility provided with the incinerator for drums is capable of either emptying the drum into the incinerator and returning the drum for reuse or charging the drum, contents and all, to the incinerator both via an air-lock system on a totally automatic basis. Our observation of the operation of this system showed it to be truly excellent. After the drums were loaded on the feed conveyor, the open head drum cover was removed and replaced with a sheet of plastic that was taped in place to prevent spillage in the conveyor handling system and in the case of material in which the drums were to be burned, contents and all, the same procedure was followed except that on the top of the plastic cover a head in which six 1" holes had been drilled was tightened in place. These holes limited the rate of leakage from the drum into the incinerator and provided a method of burning drums filled within 4" of the top with 10 to 12,000 BTU/lb. heat release material to burn evenly in the incinerator. 3M indicated that at approximately 15,000 BTU/lb. heat release material this method of controlling the burning rate became invalid.

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One surprising fact is that, in spite of their significant investment in a facility to dispose of their waste stream in an environmentally acceptable manner, they send their contaminated drums to an outside vendor for reconditioning. Considering the toxicity of many of our materials this seems unfeasible for our situation. 3M indicated that the kiln had a capacity to mechanically handle approximately 20 drums per hour, assuming that the contents of these drums were within the BTU handling capacity of the incinerator.

3M had tested a slip stream waste heat recovery unit and indicated that problems occurred with corrosion of the tubes, fouling of the tubes, and potentially lowered the on-stream time of the incinerator. The reason for not installing the waste heat recovery unit, beyond the technical problems involved, was that they had no use for a relatively low reliability steam source. Based on their experience, it appears that we should design our facility such that it is capable of having a by-pass heat recovery system added at a later date and plan on installing a slip stream waste heat recovery unit shortly after our facility is started up. The alternate is two incinerators with the "clean" one equipped for heat recovery.

3M's on-stream time experience with the incinerator was 60% for the initial operation and has now risen to 80-85% with half of the down-stream time due to scheduled turnarounds at 2-3 month intervals. One of the prime limitations on turnaround intervals is that they do not have continuous ash removal in their secondary combustion chamber and must shut down for manual removal of this ash. If they were to build a new facility they would install this feature but, due to their currently reduced volume requirements plus the added cost of modifying an existing facility, they do not plan to do this currently. In addition, the bends installed to create turbulence in the ductwork at the secondary combustion chamber were provided with ash hoppers and the hoppers are not an operable system.

In the primary kiln, Dow experiences a 2-year life on the brick and a 3-6 month life on the castable refractory at the inlet and outlet of the kiln. Life of the castable is determined by mechanical damage to it. The refractory in the kiln is a 2" layer of insulating brick, Walsh XX, and a 9" layer of super-duty fire-brick, Varnons 126-144 or 126-138. The operating temperature at the primary kiln is 1100°F with a maximum limit of 2400°F. The temperature limit on the brick is 2700°F and they periodically increase the temperature in the kiln from the normal 1100°F to 2000-2400°F to melt out slag. They had no pH data

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on their feed stocks and no information on brick attack due to alternating acid and alkali conditions.

Their current operating complement is a crew of 9, with 2 man/shift and full capacity operation utilizes a crew of 13, with 3 man/shift. They noted that the people employed in this area were a cut above their average operating personnel in the adjoining Chemelite plant and did a lot of their own minor maintenance work.

They do not handle any solids in bulk, noting that 3M is basically an adhesive company and, therefore, "sticky". Unloading of drums for handling in their bulk liquid system was initially done with Viking pumps, which proved unsatisfactory, and were replaced with air-operated diaphragm pumps which they find satisfactory. The pumps are located overhead and they use a hose and dip tube for sucking the contents out of the drum. Material from the drums flows to one of two 3,000 gallon agitated blend tanks. Following blending, it is pumped to one of five 10,000 gallon storage tanks, which also serve as incinerator feed tanks. For more viscous liquids they have a hooded dump chute directly on top of the blend tank which is equipped with an induced draft system. In general, their level of housekeeping with respect to general trash pickup was only average, but control of spills of materials to be incinerated was excellent.

Safety in the area appeared to be minimal with the operators wearing glasses but no hard hats and even while handling waste materials, respirators, face shields, goggles, aprons, etc. were noticeably absent. They had one serious explosion in their incinerator shortly after startup while burning some drums of wastes on which the materials designated had been obliterated. No one was injured in the blast, they don't know the source or the composition of the offending material, and mechanical damage was in the range of $50,000 to the facility.

The main building was approximately 250' by 100'. The overall site is approximately 5 acres, which includes space for a second incinerator and considerable free area, including a large truck/trailer storage yard. The installation took advantage of a natural hillside for incinerator layout. Offices for the supervisors and foremen are provided via trailer. The basement included fire-brick and other material storage, as well as the wet ash handling system which was a drag grate directly to a dump truck and included the basic structure for a second incinerator.

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The first floor included: (1) an 8-bay truck dock for delivery of drum wastes, (2) storage for the drums with approximately 18' of headroom, and (3) the drum feed conveyors and front end of the incinerator. The control room, which was small and cramped, also was located in this building and, surprisingly, contained windows with fire-doors despite the previous explosion they experienced. Basic control loops were feed controls for their primary and secondary liquid feed guns, draft control, pH control for ammonia neutralization of their waste water stream and an unused stack analyzer. The bulk of the other instrumentation was panel-mounted, indicators only.

The kiln was a 13' outside diameter unit with a variable drive which was currently operated at 12 rpm. They indicated that this gave them a 2-hour retention time for a drum and, depending on kiln speed, was as low as 30 minutes. They indicated they felt the kiln was capable of 120 $\bar{M}$ BTU/hr. actual capacity as opposed to the 90 $\bar{M}$ BTU/hr. designed. In addition, they had purposely designed the pollution handling system with approximately 50% excess capacity and indicated that this was extremely useful for handling surges in the kiln operation. Their current operating cost, including depreciation, is $130 M per month, or about 6¢/lb. They rate and label their waste at each production site on four basic factors: BTU content, toxicity, flammability, and for liquids, pumpable or non-pumpable and for scrap, wet or dry. The first three factors use the standard rating scale of 1 to 4. The latter factor is a yes or no situation. While handling materials that rated a 4, extreme hazard, with respect to two of the three classifications, BTU content, toxicity, and flammability, 3M limited access to the area and ran a flashing red light and horn in the area. One obvious question is why one four classification is not sufficient to activate the system. With respect to our proposed incinerator, the system appears to be inapplicable unless you have a yen for continuous horns and flashing red lights. The only compatibility problem they have with their materials is solidification of liquids that are incompatible with each other. Thus, they do not face the factors significant to our operation which will also include reactivity and corrosivity. 2

They have had significant corrosion problems in their air pollution control equipment and now use a proprietary, Trowel-On, at a thickness of 1/8" to 1/4" in the bulk of the system. They noted that thin coatings just did not work. In their stack they are currently getting good performance with a 5 part epoxy coating. Based on their comments about high concentrations of muriatic acid in the stack, one can speculate that

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their scrubbing system efficiency is less than optimum. The induced draft fan is currently built of Hastelloy C and the spare is rubber-lined. The rubber-lined spare is not held in high regard since it has a tendency to throw balance pads and also encounters the other problems inherent in rubber-lined equipment, specifically bubbling of the rubber coating and age cracking.

While we were at the incinerator the EPA and TRW, an EPA contractor on vinyl chloride waste disposal, were running base line data for a test burn.

The principal contacts at 3M were Earl Kex, Engineering Manager, and Mike Santoro, Supervisor of the incinerator. Both of these people, as well as their associates, were most open and candid with us in discussing the facility and additional details on the operation can be found in the article by Lewis, Edwards and Santoro in the October 18, 1976 issue of Chemical Engineering.

W. L. Smull

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