ROUGH DRAFT #1

AIR EMISSIONS CONTROL PROGRAM AT THE W. G. KRUMMRICH PLANT OF MONSANTO

First of all, and by way of background, I'd like to tell you some things about the W. G. Krummrich Plant of Monsanto.

It is located in the industrial municipality of Sauget, Illinois -- named after Leo Sauget who has been mayor of the Village since its inception 42 years ago. We believe that Mayor Sauget holds the world's record for continuous service in a mayorality. For a little closer orientation, Sauget Village is just southwest of East Saint Louis and is directly across the Mississippi River from Monsanto's John F. Queeny Plant at 1700 South Second Street.

Our Krummrich Plant is quite a combination of old and new. The plant celebrated its 50th anniversary as part of Monsanto last year and chemicals operations had been in existence there for a number of years before Monsanto acquired them 51 years ago. Through the years the plant has grown steadily in its production capacity and, because of this growth and because the chemical industry is one that changes rapidly, many of the facilities are relatively new. So -- we have some buildings of World War I vintage that look like this (SLIDE #1) and this (SLIDE #2) and much newer ones that look like this (SLIDE #3). This is our employes service building (SLIDE #4). Here's a modern auditorium which can seat [redacted] people and (SLIDE #5) a ~~$ [redacted] million~~ laboratory dedicated in 1966. Here's a picture of one of the new production

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facilities (SLIDE #6) and, of course, we have many situations where we have mixed modern and other facilities which are expansions of old departments (LIGHTS).

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We produce mostly basic (so-called "heavy") chemicals which are used as intermediates in the production of many of the good material things that we enjoy in our modern day life. As some examples, we have a sizeable H_2SO_4 installation. This acid is used in production of a large number of chemicals at our Queeny and Krummrich Plants and is sold outside Monsanto. I'm sure many of you have heard the statement that H_2SO_4 is so widely used that its production figures are a good barometer for general business conditions. We have a relatively old Hooker cell Cl_2 plant and a quite modern DeNora mercury cell Cl_2 plant. This Cl_2 is used to chlorinate a fair number of organic materials. One example is benzene. The chlorobenzenes (the products of the chlorination) are then used in a variety of ways for production of other chemicals which go into the production of pharmaceuticals, dyestuffs, insecticides and the like. We chlorinate toluene to produce benzyl chloride which has many uses -- a principal one being for plasticizers which go into the wonderful floor tiles we have today. We chlorinate biphenyl to produce our aroclors which in turn are used in transformers and make possible the elaborate electric distribution networks we have. We produce large amounts of phenol which is used as a building block for many other chemicals. We chlorinate large amounts of this phenol and the chlorophenols produced go into herbicides,

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diodorants, wood preservatives and many other materials.

From chlorination of these various organics we have, as a by-product, hydrogen chloride gas which when dissolved in water becomes hydrochloric or muriatic acid. Huge amounts of this acid are sold for many uses including steel pickling and food production.

We receive phosphorus from other Monsanto locations. Much of this is burned and hydrolyzed to phosphoric acid which goes into soft drinks such as the colas, and into baking powders, fertilizers and, of course, many other products. Some of the phosphorus is chlorinated and eventually winds up in gasoline additives, plasticizers and pharmaceuticals.

Some other of our products are a number of rubber additives, helping to make possible the better tires we have today, a wide variety of oil additives which contribute to the long life of our automobile engines and several agricultural herbicides - one of the reasons for the present revolution in agriculture where more and more foods are being produced by less and less people on fewer acres and at less cost to the consumer.

All in all, we produce about 80 major products with a large number of by-products and blends of products. The plant provides stable employment for 2100 people and is an important factor in the economy of our Bi-state Greater Saint Louis Area.

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So much for the background -- it was lengthy but I believe necessary for an understanding of the relationship of air emissions control to the plant. I think it's obvious that, in the handling and in the production steps involving so many materials, tight control of air emissions is a must. Without this control, a wide variety of dusts and mists and gases, many of them quite objectionable, could be released into the atmosphere. So -- we go to a great deal of expense and trouble to control air emissions and have been doing it for quite a long time. Long before I went into full time pollution control work 12 years ago, the processes where control was necessary were fitted with control devices which were good within the technological limitations of that time. Now we know a great deal more about control of air pollution than we did 12 years ago and have much better equipment, materials and processes to work with than we did then. In these 12 years we have been going through an expansion and upgrading of existing control facilities plus trying to be certain that new or drastically altered processes coming into the plant are adequately controlled so that new pollution problems are not created.

These upgrading projects have taken many different forms. We've had simple relatively inexpensive changes such as increasing heat exchanger capacity to improve condensation of gases contained in an air stream leaving a process, or piping a very small emission source to an existing fumes scrubber, or providing a water scrubber to drown vapors where stream pollution control will not be adversely affected, or even just

piping the vent from a receiving tank back to the source tank so that thee is no displacement of contaminated air to the atmosphere. It is often possible to make a significant reduction without spending a great deal of money by careful study of a problem plus use of some imagination and ingenuity.

However, most problems cannot be corrected that easily or inexpensively, so we have been spending a great deal of money on quite elaborate projects and I'd like to show some pictures of several of the projects. The first one is an odor control project -- I'm sure that it's no big surprise to many of you that we consider odor control our No. 1 and most difficult problem in air emissions control. We are a big producer (and user) of chlorophenols which have an extremely low odor threshold (about ___ parts per billion). Although the amounts which can be emitted into the atmosphere are insignificant pound-wise and certainly create no health hazard, a little goes a long way in creating odor. Chlorophenol odors can be absorbed in caustic where the phenol is converted to the sodium phenate with greatly reduced vapor pressure and, consequently, greatly reduced odor. In late 1966 and early 1967, after a great deal of technical study, we completed two scrubber installations. The first one (SLIDE #7) shows the scrubbing tower at the producing department. The tower and the extensive ductwork system, which reaches out to 34 points where odors can be released, is made of glass reinforced polyester plastic. Caustic is circulated over packing by this pump and is changed daily. This caustic has no value and

can't be sewered so it is hauled to a landfill and mixed with flyash and buried. The fan delivers ____c.f.m. of air to the scrubber which does a good job of removing the odor. Operation of this unit is not yet entirely satisfactory -- excessive failure of the fan has occurred due to some extent to condensation of moisture from compression in the fan. Trouble has been experienced with functioning of some of the equipment at odor pick-up points so revisions have been made and are still going on. However, a big improvement in odor level has been noted and we intend to keep after this until the operation is fully satisfactory. Original cost of this was $300,000 and will likely be up to $400,000 before we're finished.

The next slide (SLIDE #8) shows a similar installation at our 2,4-D herbicide department. This is a considerably less complex installation and results from it have been generally more satisfactory than the first scrubber we saw. The caustic recirculated in this installation is usable in the process so we at least are spared the cost of the caustic and the expense of disposal. This installation cost $200,000 and is being expanded gradually to pick up more possible odor source points.

In early 1967 we put on the line a new H_2SO_4 plant to replace two older small units and, at the same time, upgraded an existing unit. These two plants were designed to meet the then tightest restrictions in the country and to at least

equal performance of any normal plant in the country. Net effect of the upgrading was to reduce previous air emissions by 40%. We are pleased with performance from these units and the reduction in air emissions is beyond our expectations. One of the benefits was the essentially complete elimination of visible plume in the new unit by installation of a Brink mist eliminator. Here's a picture of the Brink unit (SLIDE #9) which is filled with glass fiber-packed cartridges about 2' in diameter and 10' long. These glass fibers almost completely (over 99%) trap the very tiny particles of H_2SO_4 mist which make up the white plumes normally characteristic of H_2SO_4 plants.

(SHOW SCHEMATIC SLIDE [#10] OF BRINK MIST ELIMINATOR IF GREENWELL SUPPLIES IT)

Here are pictures of several other Brink mist eliminators as used for trapping sulfuric acid mist. Two at our chlorosulphonic acid production department (SLIDE #11) -- chlorosulphonic acid is used in production of saccharine, shampoos and many other products. Here's one at the sulfuric acid catalyst department (SLIDE #12) and an interesting shot of the eliminator used to remove mist from our oleum (that's very strong sulfuric acid) storage tanks (SLIDE #13). In the glass piping at the left you can see the cloud of acid particles in the air going to the eliminator. At the right is the clear air stream leaving the eliminator. These Brink mist eliminators are effective enough to remove cigarette smoke as from the air in this room.

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One of the rather ubiquitous problems we have in the plant is loading of tank cars and tank trucks where fumes or odors are emitted by displacement of the air in the tank car or truck. Due to the wide variety of sizes, types and heights of dome openings to which the fumes collection equipment must be adapted, and to the necessity for the loading operator to be able to detect when the tank car or truck is full, we have real problems in adequately collecting these fumes for scrubbing or otherwise controlling them. Through the years we have invested a lot of money and technical effort in various schemes and gadgets, but mostly these haven't worked very well except for the method of placing a large flexible intake duct hose end just inside the dome of the tank being loaded. With a big enough suction source and a large enough scrubber to handle the large volume of contaminated air, the system could be made to work by simply overwhelming the problem. The next slide (SLIDE #14) shows a quite new installation at our muriatic acid car loading area. (Describe action of this equipment.) We have high hopes for the continued successful use of this type of fume removal connector for our tank cars and trucks being loaded. If it does work out, we will utilize it widely through the plant to replace our less efficient and more troublesome installations. (LIGHTS)

Well, I could go on for a long time telling you about and showing you pictures of the newer projects which have been installed and the projects which are under way. This has been and is a major effort for our plant. During the past several years we have

been completing about 20-30 air emissions control projects each year and spending has risen to over $1/2 million annually during the past two years. We expect to continue at about this same rate during the next several years as we move to upgrade fly-ash collection at our power house, tighten up and improve on chlorophenols odor control, attack other odor sources, etc.

So much for this capital expenditures -- they are a very important and expensive part of any improvement program. However, an extremely important part of any conservation type program (safety, housekeeping, water wastes or air emissions control) is the support and cooperation of the plant people. A program of this nature cannot be successful without <u>people</u> support regardless of the capital money that is spent for projects. Air emissions can occur in many ways besides the regular problems characteristic of the equipment in a production department. Here are some of these ways:

1. Equipment not operated as well as it should be can cause air emissions.
2. Operating difficulties not well recognized can result in lengthy emissions.
3. Equipment not promptly or properly repaired can cause emissions, as from a leaking pipe line.
4. During unusual conditions, such as during equipment repairs or equipment change-over, emissions are particularly prone to occur as a result of inability to foresee everything that is good possibly happen -- in other words, anything less than perfect planning.

Now, I think you can see that, in all of these cases I've mentioned, people are involved and, of course, some of the good, and the less than good, characteristics associated with people.

No, of course, we have always been interested in top-notch performance of all of our people in all of their responsibilities and, certainly, their performance in air emissions control was no exception. But in line with increasing priority for air emissions control, we instituted two years ago, a formal education program which I hope you'll find interesting and which may be, at least to some of you, helpful.

Our Krummrich Plant program was developed by a small group including Production, Maintenance, our Communications Group and, of course, our Waste Control Group. We started on the basis that this would be a major plant effort and that we would need the active cooperative commitment of everyone in the plant to the program.

"Good-Neibbor" Policy

In control of air emissions, we will conform to Monsanto's policy which states "To be a good neighbor in all that it implies and a substantial contributor to the general welfare of society." In addition to the greater responsibility of being a good neighbor, we must comply with regulations of control agencies.

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Here are objectives we set for our plant (SLIDE #16):

"Air emissions will be controlled at optimum cost at a level which will:

a. Enhance the reputation of the Krummrich Plant and Monsanto.

b. Create no hazard to employes or nuisance to the public or to our industrial neighbors.

c. Result in no external damage to property."

(LIGHTS)

We next outlined the responsibilities for all of the functional groups in the plant. This was lengthy and I won't discuss it tonight except to say that a responsibility common to <u>everyone</u> in the plant is reporting of emissions.

For our Plant Operations Manual (that's our general plant operating guide) we have been developing operating procedures. There will be at least four procedures -- one on Reporting (or collecting factual information on air emissions so that we can move XXXX to correct them), one on Emissions-Process Audits which will be a procedure for systematic periodic review of condition and performance of all control equipment, a procedure establishing priorities for correction of air emission sources, and a procedure for careful review of plans for any new or altered operations to be certain that these new operations will not contribute any pollution problems.

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I'd like to show you some of the features of our Reporting Procedures. First, we have our internal reporting system which

we call our A-I-R program. I mentioned earlier that a responsibility of everyone in the plant is to report any air emission that he detects. We are proceeding on the basis that if we can detect and control problems inside our plant, not very much is going to get outside the plant. This A-I-R program is the mechanism to provide for ease of reporting and effectiveness of follow-up in correction. In every control room, in the laboratories, in the shops and in many other places throughout the plant are posted these adhesive-backed instructions (SLIDE #17, A-I-R stickers -- explain how reports are called in). A girl in the plant communications office (SLIDE #18 - Peggy Anderson) types the message on to a 5-sheet pressure sensitive form. Here's the flow diagram of handling of these forms (SLIDE #19 - explain). Here is a copy of one of the forms as filled out (SLIDE #20). Information from these forms is coded and put on data processing cards for classifying in many different ways for maximum information output.

We are quite pleased with the degree of success of this program. It has been a real help in pinpointing trouble areas and in establishing priorities for correction. However, I'm sure that the biggest gain has been in the personal involvement of our people in every job classification in helping to do their part in helping to correct and control our problems.

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Here is our flow diagram for handling of any reports of

of emissions from outside our company (SLIDE #21). I won't go through this except to say that any complaint is promptly and sympathetically handled and, where possible, the General Superintendent of the emitting department is personally involved in the follow-up with the complainant and that we always try to take preventive and corrective action so that we don't have recurrence. (LIGHTS)

Another part of our reporting procedure is our appointment of Pollution Investigation Committees. If a serious incident occurs and it appears that the lessons to be learned from it can be applied to other parts of the plant, the Plant Manager appoints an investigation committee, usually about five persons. The people appointed drop their other work and thoroughly and deeply investigate the cause and make recommendations for the specific area involved and for the plant as a whole. These recommendations, after study and acceptance by the Plant Manager, are carried out and regular progress reports are issued until the work is completed in all of the appropriate areas of the plant.

Other parts of our reporting procedure have to do with vent stacks where a continuous monitor, such as a recorder, is provided. Operating of these monitors is the responsibility of the production department supervision and they are to report up the line when control limits are exceeded or the monitors are out of order.

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Responsibility for measuring stack emissions not monitored

by instrumentation and for over-all plant monitoring is the responsibility of our Wastes Control Group in our Technical Services Department. Here's a picture of the group (SLIDE #22), three engineers and two engineering aids charged with over-all coordination of plant effort in wastes control. Note that I did not say that this group is responsible for waste control. We believe strongly in, and adhere to, the principle that control of wastes is the responsibility of the department that produces the waste and this responsibility cannot be delegated to a staff group.

Here are some pictures of our group at work measuring stack emissions. This (SLIDE #23) shows measurement of the vent from H_3PO_4. This has a rather sizeable and impressive plume which actually is nearly all steam with very little and quite unobnoxious material in it. However, it does add to the haze. Here's (SLIDE #24) testing of the power house stacks under way. The job of keeping an up-to-date emissions inventory is a big one in a plant as large as ours and with as many changes as we have.

One of the functions of the waste control group is detection of any particulate emission such as dust or mist which could settle down and cause, for example, paint damage. We have _____ stations where filter paper is exposed in and around the plant (SLIDE #25). This paper is inspected daily for any visual spotting and is tested for invisible spotting as from acidic or alkaline mist. Techniques for identification

of almost incredibly tiny amounts of material caught on the paper have been developed in our laboratory so any spotting is analyzed and reported. It is, of course, helpful to know when the spotting occurred and so we developed a timer sampler (SLIDE #26) which exposes the paper according to time. We have three of these in use and plan to make more of them. They are powered by a battery operated clock which is O.K. except during heavy winds and rain and the like. We want to develop a more powerful driving mechanism and will do it sometime when we can get to it.

Because of our power house and our H_2SO_4 installations and because we are in an industrial community, we are interested in sulfur oxides concentrations in and around our plant. At the time we started developing our scheme for monitoring SO_2 we wanted to set up eight stations around the periphery of our plant, we wanted relatively short term results such as 1 or 2 hour averages, we wanted to use the West-Goeke method because of possible interferers with other methods, we wanted reliability and freedom from attention and maintenance on week-ends and, of course, we wanted minimum capital and operating cost. We could not find any equipment which we felt adequately met all of those needs so we developed our own samplers, borrowing some ideas from water waste samplers which we had developed several years prior. Here's the sampler (SLIDE #27) -- the West-Gaeke solution is contained in the test tube racks on either side. Air to be sampled is drawn through a critical orifice into a stainless steel diaphragm pump which pumps the air through a dip tube arrangement which dips alternately into the test 0736925

tubes on a timed sequence moving down the racks of tubes on eitner a 1-hour or a 2-hour cycle. The test tube racks are collected daily, the tubes are capped and are taken to a Technicon autoanalyzer for SO_2 determination. There are enough tubes in the racks so that, by setting the sampler on 2-hour cycle, it will run over a week-end without attention.

This outfit has worked well for us -- our prototype unit as finally developed was virtually trouble-free. Our first regular units have had problems resulting from lack of sufficient precision in construction but now appear to be generally O.K. We have not had the opportunity (or I should say, have not taken the necessary time) to test the unit against absolute standards such as diffusion tubes, but we have tested it against other SO_2 samplers using a common air source and results were quite comparable.

For those of you who have not seen an automated analyzer, here's ours at our laboratory (SLIDE #28). We have two of these -- one for SO_2 and one for water sample testing. With some intelligent loving care, these units give us quite adequate results and are tremendous time and labor savers. (LIGHTS)

Eight sampling stations at 24 samples per station yield a lot of data to be handled and we have dreams of feeding these data plus information from our wind direction and velocity recorder in to a computer for recording for pinpointing trouble areas. Also, we want to eventually use our sampling and testing equipment for measuring other possible pollutants, but

obviously can't do everything at the same time.

This concludes my discussion of our emissions reduction program at our Krummrich Plant. In summary, I would like to leave you with several thoughts which, I hope, will have been apparent from the discussion. These are:

1. We are quite aware of our problems and are accepting our responsibility for correcting these problems.
2. We are expending a great deal of money and of our people resources in this correction and control work and, I believe, have developed an efficient, effective program for use of these resources.
3. Significant improvements have been made and more are forthcoming. However, there is no magic date by which we can say there will be no more problems. I'm sure that as we progress and as more of the other over-all Greater Saint Louis Area problems come under better control, everyone's standards will change so I think we can see need for steady continual improvement from now on.

Paul B. Hodges

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