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REPORT ON

"SUMMARY OF THE PLANT INDUSTRIAL HYGIENE PROBLEMS"

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April 12, 1949

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NEW YORK 20, NEW YORK

SUMMARY OF THE PLANT INDUSTRIAL HYGIENE PROBLEMS OBSERVED IN SEVERAL REFINERIES ESSO COMPANY

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In the time allotted to me, I should like to discuss the industrial hygiene problems in the Esso Company on the basis of broad groupings into the type of exposures. I believe that this approach, rather than by operation, will point up more clearly the responsibilities of the industrial hygienist. The following is a partial list:

1. Exposure to toxic gases, vapors, and mists
2. Exposure to toxic fumes and dusts
3. Industrial dermatitis
   a. Primary irritants
   b. Sensitizing agents
4. Exposure to carcinogens
5. Excessive heat
6. Excessive noise
7. Inadequate illumination
8. Inadequate ventilation
   a. General
   b. Local exhaust
9. Vibrating tools
10. Atmospheric pollution
11. Sanitary facilities
12. Special problems

Toxic gases, vapors, and mists occur quite generally throughout the refineries; from hydrogen sulfide in the processing of sour crudes, to mercury vapor in the instrument shops; from sulfur dioxide in sludge cooking,

to carbon monoxide in synthesis gas, and from benzol vapors in solvent dewaxing, to the mists associated with drum painting. Other potential exposures are to oxides of nitrogen, merceptans, ammonia, chlorine, toluol, xylol and other aromatics, acetone, methyl ethyl ketone, methyl propyl ketone, methyl chloride, carbon tetrachloride, boron trifluoride, aluminum chloride, hydrogen chloride, sulfur trioxide, lead tetraethyl, phenol, sulfur trioxide, aliphatic hydrocarbons both saturated and unsaturated, vaporized lube and grease additives, vaporized and sublimed plasticizers, alcohols from methyl to iso-octyl, ethers, esters, and others.

Fumes and dusts are encountered almost as widely. There are welding fumes in maintenance operations and occasional heavy exposures to siliceous catalyst dusts, coke dust from equipment cleaning and litharge dust in Doctor sweetening, asbestos dust in insulating operations and talc dust in rubber manufacture. Catalyst manufacture offers a wide variety of dust exposures. Lube and grease manufacture offer exposures to diatomaceous earth, several types of clays, graphite, metal stearates, lime, asbestos, mica, and others. Metallizing operations, lead burning, sand blasting and pipe reconditioning -- all present potential industrial hygiene problems.

The problem of industrial dermatitis is like the poor -- always with us. The problems vary from those associated with defatting of the skin, as would occur on intimate contact with certain petroleum fractions, to those accompanying the use of harsh abrasives and detergents in hand cleansers. There are plant exposures to primary skin irritants, such as the mineral acids and alkalis, and to more serious substances, as the chromates. Cutting oils, gasoline, lube, and grease additives present opportunities for contact with primary irritants, as well as sensitizing agents.

Exposure to carcinogens, known and suspected, dips heavily into the time and energy of the industrial hygienist. All of us are familiar with the problem associated with wax pressing. The control of this problem, however, may not be sufficiently complete as statistical evidence is mounting that the incidence of systemic manifestations among this group of employees is out of line with that for the general refinery population and the population at large. The control program must be continually observed and reviewed to insure that maximum worker protection is provided.

Animal experimentation has indicated that certain heavy fractions from catalytic cracking are potentially carcinogenic to man, as are the tars from steam cracking and thermal reforming. The control programs for these materials have been discussed in detail and need not be reviewed at this time except to indicate that they represent a significant effort on the part of industrial hygiene personnel, past and present, and there is every reason to believe that even greater industrial hygiene effort will be required before all groups concerned with the problem are sure that a satisfactory control program has been evolved, inaugurated, and is running smoothly.

Excessive heat exposures cannot be solved for plant personnel as easily as for office employees where the latter can be sent home in the middle of the afternoon if it gets too hot. Such exposures, directly associated with the work, occur in such widely varied activities as pipe bending and furnace thermocouple servicing, certain boiler house activities, and working in confined areas where the equipment has not cooled down entirely. During certain seasons, any physical labor of a strenuous type, and especially if it is performed in direct sunlight, may represent an occupational exposure of no mean significance.

A medical opinion has been expressed in certain of the refineries that hearing impairment is relatively common among certain groups of workers, such as the boilermakers. However, high noise levels are encountered in other parts of the refinery as well. Potentially undesirable noise levels might be encountered in the vicinity of high-speed pumps, in compressor rooms, in generator rooms of the power houses, to mention only a few.

Inadequate illumination is a problem that affects clerical personnel as much and as often as process workers. Satisfactory illumination must be considered in close conjunction with the job to be performed and is a composite of a number of items -- the intensity of the light, its color, contrast, amount of glare, and angle of incidence. Potential difficulties arising from inadequate illumination may be encountered in any area of the refinery but is most likely to arise from clerical activities.

Fortunately, the open type of construction employed in petroleum refining reduces the number and variety of general ventilation problems with which the industrial hygienist must contend. On the other hand, there are numerous instances where enclosures have been constructed for the shelter of men and/or equipment, and the ventilation of these spaces then becomes a problem. Pump houses frequently offer exposures to hydrogen sulfide; compressor houses may provide exposures not only to hydrogen sulfide, but also to methyl chloride, ammonia, or some other refrigerant.

In many cases local exhaust ventilation is required for specific operations. Each of us is familiar with the spray paint booth and the laboratory hood, but the need for this type of ventilation can be demonstrated for metallizing operations, permanent welding locations, degreasers, and driers, calenders, and dusting machines in rubber manufacture.

As in the case of illumination, each operation must be considered on an individual basis. If no ventilation is provided, then the need for such control must be demonstrated and assistance provided to be sure that the system will be of the correct design and of suitable capacity. Because ventilation for health protection is so poorly understood, every industrial hygienist must be conversant with hood and duct design, fan types, and the proper collector to use for the specific contaminant. The capital outlay for a satisfactory ventilating system is far too large to permit unconcern over its future performance by the industrial hygienist.

Vibrating tools are in use throughout the plants and their effects are of interest from an occupational standpoint. Those instruments range from electrically driven star drills, to jackhammers and pavement breakers; and from the use of chipping chisels, to riveting operations. These need to be scrutinized from the standpoint of frequency and duration of use, the number of cycles per minute, and features peculiar to the activity that may have significant medical implications. Since the smog incident at Donora, Pennsylvania, currently being investigated by the Industrial Hygiene Division, U.S. Public Health Service, the specter of atmospheric pollution has haunted the industrial hygienist. This individual is trained and experienced on the evaluation and control of atmospheric contaminants within a plant and it is only a small step, and a very logical one, for him to be called upon for similar functions related to the discharge of undesirable contaminants into the atmosphere of a community. All of the Esso refineries are located in urban areas, and it is not unlikely that the work load of the industrial hygienist will be augmented by being called upon in some degree to assist management in this field of endeavor.

With respect to sanitary facilities, it would be desirable to be assured that all governmental requirements are met and exceeded and that any control program, as in the case of the carcinogens, will not be impeded by the lack of lavatories and showers. In certain of our establishments, the lack of suitable facilities, their location, or their physical condition, is a very real problem. On the other hand, this condition is being steadily alleviated, and the next few years should find the situation much improved.

In addition to the industrial hygiene problems and activities previously enumerated, there are others, real or alleged, that require investigation. Yesterday we heard of the cancer problem associated with the manufacture of isopropyl alcohol at the Bayway Refinery. This problem, considered acute by the local management because of the employee relations aspect, has entailed a tremendous amount of effort and the end is not in sight. Developing incidence figures for the Chemical Products area alone utilized all available personnel from the Medical Department of the Jersey Company and our own for several weeks, and incidence figures for the alcohol plant are just now being completed. The etiologic agent is not known but no effort is being spared to identify it. Only after the problem has been well defined will it be possible to set up an intelligent control program. The facts evolved at Bayway must then be translated, insofar as they are comparable, into a program at Baton Rouge.

Several studies of a similar type may be in order in other refineries, inasmuch as statements relative to the incidences of certain medical entities have been made and should either be substantiated or disproved.

CMB
April 11, 1949

INDUSTRIAL HYGIENE PROBLEMS OBSERVED IN THE BAYTOWN REFINERY

J. W. Hammond, M.S.

In 1948 a survey of the Baytown Refinery and the Specialty Plant was made with the assistance of Mr. N. V. Hendricks. The purposes of this survey were to determine the materials and conditions of health significance and acquaint the Industrial Hygienist with the technical operations, materials, and products which are handled in the Refinery and the Specialty Plant. These operations and the nature of the materials were investigated for the purpose of locating any problem associated with refinery operations that might have an adverse effect on the health of the employees. Some of the questions that were studied which seem to be the most outstanding are presented in the summary attached. The subjects shown are by no means a complete list of observed industrial hygiene problems associated with refinery operations and the manufacture of petroleum specialties.

On page one of the Summary the sanitary phases of the industrial hygiene survey are briefly presented. The question of protection of the drinking water supply and the method of bacteriologically checking this for unsuspected sources of contamination were investigated. As a result of this investigation several weaknesses were brought out. The method of collecting samples was changed to include samples every three months from the foremost ends of the water mains in addition to collecting samples at a point very near the well site. This new program has disclosed, on one or two occasions, minor contamination which has resulted in a more careful control over the entire system. It was observed during this survey that there were several fountains and other places where employees obtained their drinking water that did not meet with the minimum standard from the standpoint of sanitation. A program is now underway with the orders being issued from the manager of the refinery to replace all unapproved type of fountains, thus to eliminate any

cross infection of the personnel by this means. The old type of drinking water cans are being replaced by a sanitary type which keeps the water and ice separated. Until the new type of cans can be substituted in every instance, chlorine tablets are being used to sterilize the drinking water mixture in the insanitary type of cans.

The refuse and sewage disposal methods were studied. The good sanitary program such as, the construction of the sewage disposal plant, installation of sewerage lines to separate the storm and industrial waste drains from the sanitary sewers, and replacement of all the open-type privies, has been greatly accelerated since this survey. This survey pointed out through the report that communicable diseases were easily transmitted by various insects under the existing conditions in the Refinery.

The washing and sanitary facilities available to the employees were reviewed. Recommendations for the increase in the number of these facilities were made and in many cases the needed changes or additions have been secured. This program has been well underway since before the connection of the Industrial Hygienist with the Company, but due to the bringing to light of many industrial hygiene problems which would dictate the need for the expansion of the facilities, this program has now reached the stage that the approval of requested facilities from top management is assured if they are essential in the medical program. By the beginning of the year 1950, the facilities which were seen to have been needed will be completed or under construction. In a few locations where toxic materials were being handled and the nature of the work made it necessary for the employees to get badly soiled, hot water has been added to the present washing facilities. The presence of toxic materials was brought to the attention of the Management to justify the added expense of installing hot water.

It will only be possible in the few minutes that have been allotted to me to cover the most outstanding hazards associated with toxic materials.

First, from the standpoint of the number of employees exposed and the general presence of the material throughout the Refinery, one would have to list hydrogen and organic sulfides. Prior to this survey, several cases of serious eye irritation came to the attention of the Medical Division from a low grade exposure of rather long duration to sulfides. At another location this survey disclosed that there was a rather serious possibility of eye irritation from the presence of hydrogen sulfide. Before any action was taken on the recommendation, such as instigating a detailed study of this location and recommending adequate ventilation, several eye cases reported to the hospital for treatment from this unit. There still exists the need for a detailed and quantitative investigation of these sulfides in many other units. This gas has been responsible for very serious, acute poisoning and some cases have resulted in fatalities. Under the existing conditions, the precautions used, and the concentrations of sulfide that are now found, it is the opinion that the danger is not only eye irritation, but possibly chronic systemic poisoning from low concentrations. The currently used sulfide detector is not sensitive enough to pick up concentrations of these gases which will produce physiological effects. An adequate appraisal would depend upon using absolute quantitative chemical methods and integrated samples.

There are at least five skilled crafts where possibility of plumbism exists. To date no investigation of this problem in the nature of either atmospheric samples or lead excretion values of body fluids has been carried out. This latter will soon be undertaken by the analytical laboratory.

Mercury is extensively used by the laboratory analytical group, the research engineers, and handled in large quantities by the Instrument Men.

This potential problem has received a great deal of attention from the Medical Division through having employees with the greatest exposure report to the hospital so that urine specimens could be collected and submitted to the analytical laboratory for analysis. More than 60 samples have been collected and checked for mercury so far. This study is continuing. In several locations mercury vapors have been found by atmospheric sampling. In some of these locations where mercury is regularly used, a weekly check is being made and a record kept by the operating personnel or the analytical laboratory at the request of the departmental supervisor. Other heavy metals which have been located and we know present enough exposure that they should be studied are zinc, chromate, cadmium, and to a lesser degree, beryllium. Up to the present time no quantitative values are available on these materials.

Silica and asbestos are both extensively used in the Refinery by a limited number of employees. To date the only quantitative study we have made dealt with the composition of contact clay. The free silica content of these clays has been determined by a careful chemical analysis assisted by x-ray spectograph. It is felt that a study on the atmospheric concentrations on silica and silicate dust associated with relining the furnaces is of immediate importance. Silica bricks are commonly used in lining the furnaces used in the Refinery. Even where silicate bricks are used, it is known that in high temperatures these silicates decompose to form very dangerous forms of silica, cristobalite, and tridymite.

The exposure to asbestos under normal operating conditions in the Refinery is not extensive but frequently it is necessary for an insulator to do work inside of a closed space with limited ventilation, making it possible that a high concentration of asbestos dust may be engendered. Also, the

asbestos insulations are sawed by power saws which give off rather heavy clouds of dust. This problem should be studied.

The analysis for free silica in contact lubo clays disclosed that the average concentration is about five percent. This is valuable information in view of the fact that the Public Health Service has on record an analysis of a similar type clay which they claim to have contained 20% free silica. It further behooves us to make fairly complete surveys of the locations where silicate is apparently being handled, including the Rubber Plant where talc is applied to the finished rubber. Such a detailed study, with complete dust counts at various locations and exposures, will be invaluable for our records should we later be confronted with complaints and claims from former employees who might have worked at these locations. No doubt the dust counts will disclose some unnecessarily dusty operations that can be controlled by mechanical means.

At the Acid Plant and at the SO_2 Plants, low concentrations of sulfur dioxide and trioxides are potential problems. Many complaints have been received at various times from the Acid Plant, and it was observed that various operations carried out there involve irritating concentrations. As a happy result of an active department management's attempt to improve these conditions, the current situation is much improved. The proof of these improvements was recently brought to our attention when it was reported that employees are now requesting to be assigned to the Acid Plant rather than trying in every way possible to get transferred away. Not all of the problems have been solved, but much money for the purpose of improving this area has been spent and even more has been requested.

In connection with the sulfur oxide problem, not only in the Refinery proper but in the surrounding community, a study has been instigated to take

atmospheric samples at various distances from the Refinery to establish information pertaining to the concentrations that may exist under varying weather conditions. It is planned that this study will be prolonged over a period of years, if necessary, to establish enough factual analytical data that a decision can be reached as to the extent of the problem with waste gases. A preliminary investigation as to the extent of vegetation damage in the vicinity of the Refinery has already been started. It was observed during this survey that fairly high concentrations of nitrogen dioxide existed in four small buildings associated with the Acid Plant. Atmospheric samples disclosed that the nitrogen dioxide exposure was a very serious problem to anyone having to enter the building even for a short period. Warning signs have been placed in this area and Management has ordered that the engineers design adequate ventilation to reduce the concentrations of nitrogen dioxide to those that are recognized as harmless.

Concentrations of benzol were detected in the atmosphere at the MEK Plant, in some of the laboratories, and at the Bottle Laundry which were believed to be excessive for prolonged exposure. As a result of the educational work accomplished through this survey, the MEK Plant supervisor has initiated the removal of benzene and the substitution of toluene in its stead. This substitution does not control the problem entirely, but it diminishes the seriousness of it.

Other aromatics, including toluene and xylol, cumene, and others are manufactured in large quantities. These exposures are considered in many cases to be within accepted limits, but there is no way of being sure as to the effect that they may produce on the health of the employees without making sufficient atmospheric examinations to establish the range and duration of exposure.

It is a common practice to use chlorinated hydrocarbons to clean electrical motors and various instruments in two or more departments of the Refinery. This problem is being currently studied in detail with the assistance of the safety engineers. This study will include not only the Refinery and the Specialty Plant, but also the Production Department and Humble Pipe Line Company's operations.

Varcol was found being used freely without regard to the 15% aromatics it contains.

In a few units heat, which has been the cause of various fatigue cases as well as the source of many complaints, was observed. Time has not permitted any detailed study of the problems associated with heat and noise, but it is felt that it is important enough that such a study is justified.

In most cases, these studies have been carried out by the operating personnel in charge of the various departments with the assistance of the laboratories which are available to them. The Medical Division has served as consultant on making available approved type analytical methods to be used in atmospheric testing, analysis of urine samples, and to interpret the results that the analyst reports. In some departments the supervisor has not felt that they had qualified personnel, supplies, equipment, or the time to make these indicated surveys. In these cases, when possible, the Industrial Hygienist has carried out the chemical and engineering services. In some instances the equipment and time were not available to the Industrial Hygienist and he has turned to the industrial hygiene services of the Texas State Department of Health for assistance on a quantitative appraisal of the toxic materials known to be present in the atmosphere. These public officials have been very cooperative in every way in trying to further the general well-being of the Humble employees.

Time does not permit me to touch on many of the other problems, some of which are as major as these, that have been uncovered, nor is this the meeting to report on the sanitary engineering aspect of the work which has been carried out in close cooperation with the civil engineers of the Company. It is sufficient to say that, as a result of these activities, the various engineering standards and guides have been rewritten with the view in mind of making it possible for the uninitiated engineer to supervise construction of adequate water and sewage facilities to protect employees' health. This phase of the problem seems to have met with complete approval of Management.

JWH
April 12, 1949

APPENDIX

SUMMARY OF PRELIMINARY INDUSTRIAL HYGIENE SURVEY AT BAYTOWN

Condition and Facility	Potential Diseases	Department or Craft Affected By Recommendation
Drinking Water, Fountains and Coolers	Twenty-one Communicable Diseases	Turnaround and Labor Gangs, and Twenty or More Units
Sewage Disposal	Ten Communicable Diseases	All Units and Personnel
Washing and Sanitary Facilities	Skin Irritation (dermatitis) and Systemic Poisoning	Mechanical, Labor, Processing and Others

SUMMARY OF PRELIMINARY INDUSTRIAL HYGIENE SURVEY AT BAYTOWN

Material or Condition	Potential Diseases	Departments or Crafts Affected By Recommendations
Hydrogen and Organic Sulfides	Eye Irritation and Ulceration. Systemic Poisoning	Distillation, Light Ends, Cracking, Treaters, Pumping. Gauging, Mechanical & Others
Lead	Plumbism	Labor, Painting, Welding and Burning and Machine Shop
Mercury	Mercurialism	Instrument, Laboratory, Warehouse and Pilot Plant
Zinc, Metal Fumes	Fume Fever, and Systemic Poisoning	Mechanical
Chromates and Beryllium (Slight Exp.)	Lung Cancer and Skin Tumor	Painting, Mechanical & Labor
Silica and Asbestos	Silicosis, Fiberosis, Erythema & Cancer of Lungs	Brick Masons & Helpers, Insulators, Laborers and Pipe Benders

SUMMARY OF PRELIMINARY INDUSTRIAL HYGIENE SURVEY AT BAYTOWN

Material or Condition	Potential Effects	Department or Craft Affected by Recommendations
Silicates and Coke Dust	Fibrosis, and Possibly Lung Tumors	Contact, Straining and Blending, Cracking Coils and Labor
Sulfur Dioxide and Trioxide and Acid Mist	Irritation, Asthma, and Poisoning	Treaters, Acid Plant, Batteries, and SO_2 Plants
Nitrogen Dioxide	Edema of Lungs	Acid Plant and Welding

SUMMARY OF PRELIMINARY INDUSTRIAL HYGIENE SURVEY AT BAYTOWN
(Continued)

Material or Condition	Potential Effects	Department or Craft Affected by Recommendations
Benzol	Blood Disease and Cancer	MEK Plant, Laboratory and Bottle Laundry
Toluol, Xylol and Heavy Aromatics	Blood Disease	MEK, SO_2 Plants, LEFU, NRU, and P & G Units
Varsol and High Aromatic Naphtha	Dermatitis and Blood Disease	Generally Used Throughout Refinery
Chlorinated Hydrocarbons	Cirrhosis of Liver	Instrument & Electrical
Heat and Noise	General Malaise, Exhaustion and Deafness	Maintenance Crews, Pumpers, Boiler and Power Houses Personnel

SUMMARY OF INDUSTRIAL HYGIENE PROBLEMS IN CONNECTION WITH SOME STANDARD OIL DEVELOPMENT COMPANY'S ESSO LABORATORIES RESEARCH PROJECTS AT BATON ROUGE (LOUISIANA) REFINERY

Roy S. Bonsib, A.M., E.M.

For the past five or six years, periodic visits have been made to the Baton Rouge (Louisiana) Refinery to discuss new research projects with those directly concerned and to inspect recent pilot plants, in order to insure that the necessary precautionary measures are incorporated as an integral part of process instructions and included in the design of new equipment. Many of the research projects include new compounds such as tetrahydrophthalimide and perchloromercaptan, the toxicity or physiological effects of which are unknown although their physical and chemical properties are perfectly familiar. In such cases, we have endeavored to obtain the missing toxicological information through surveys of the available literature, visits to plants manufacturing or working with the material in question and by personal discussions with qualified individuals who have studied the toxic properties of the particular compound or similar ones.

Esso Laboratories at Baton Rouge are now carrying on a number of new projects which present definite industrial hygiene problems and health hazards. For patent security reasons it will not be feasible to discuss some of the most difficult problems but merely mention a few of the compounds involved; however, several typical projects will be presented as illustrations of some of the problems encountered and a list of those which have been considered in detail will be given at the conclusion of this paper. For example:

RETORTING OF OIL SHALE - At the present time over a thousand tons of crushed oil shale from Rifle, Colorado are being fluidized and retorted for the United States Bureau of Mines at the rate of about 20 tons per day. Although very little is known regarding the physiological effects of American Shale Oils, Scottish Shale Oils, which are similar in composition, have been definitely

shown to be carcinogenic; consequently, American Shale Oils may be presumed to be carcinogenic also. In addition to the possible hazard due to skin contact with shale oils, the inhalation of oil mists or vapors and the spent shale dust are potential hazards. Then too, aromatic compounds of nitrogen, principally as amines, and sulphur, present as thiophenes or mercaptans, may also be sources of trouble.

HYDROCARBON SYNTHESES - A series of small pilot units, as well as one or two larger ones, are now operating at temperatures ranging from 480°F. to 950°F. and pressures ranging from atmospheric to 3000 pounds per square inch using various types of catalysts. The principal one of these synthetic hydrocarbon operations is the OXO Synthesis, in which an Olefin, hydrogen, and carbon monoxide produce an aldehyde in the presence of an iron or cobalt catalyst. This aldehyde is then converted into an alcohol such as octanol. The main points of possible hazards are the Carbon Monoxide in the synthesis gas which is under 3000 pounds pressure, Cobalt Carbonyl present as the catalyst in step 1, and the Aldehydes present as product from step 1 and as feed to step 2.

CATALYSTS INVESTIGATIONS - A definite pneumonoconiosis hazard is encountered in the grinding, blending, screening and pilling operations involved in the production and study of new catalysts. A new hydroforming catalyst is now being made which requires some exposure to Pentasol and Mercuric Chloride. Other catalysts require the use and handling of very finely divided (less than 3 microns) charcoal and iron oxide, as well as compounds of Cobalt, Manganese and Beryllium.

Arrangements were recently made to pill 45,000 pounds of an oxidation catalyst made by the Davidson Chemical Company. This catalyst contains about 6.5 percent Vanadium Pentoxide, the balance being a silicate. "Ludox", a liquid silicate, is added to facilitate the pilling.

CHEMICAL REFINING OF GASOLINE - A new and more effective method of refining gasoline and naphthas is being investigated in which a colloidal Sodium Paste in Toluol, Sulphuric Acid and Formaldehyde will be employed.

METALLIC MERCURY - A hazard continuously encountered around research laboratories results from leaving spilled metallic Mercury lying around to contaminate the atmosphere. This unsafe practice is usually prevalent in Instrument Repair Shops. The use of Mercury Boilers operated at a temperature of 900°F. and a pressure of 80 pounds per square inch also present a definite Mercurialism hazard unless certain precautionary measures are carefully observed.

C-OIL PROJECT - Dioxane, a very volatile and inflammable solvent, is used in the preparation of C-Oil. Besides causing serious kidney injury, Dioxane also attacks the liver seriously.

POLYMERIZATION PROJECTS - A wide variety of studies are under way for the production of synthetic resins and rubber-like materials. These studies not only expose the investigators to the known hazards of such materials as Methyl Chloride, Acryolnitrile, and the various antioxidants and inhibitors, but newer irritant compounds such as Boron Trichloride, and Brominated Xylenes and Pentanes.

DETERGENT ALKYLATES - Considerable active interest is being taken in the production of a detergent alkylate which is obtained by the alkylation of Benzene with a C_{12} Olefin fraction using Aluminum Chloride as a catalyst. The hazardous materials used in this project being Benzene and Aluminum Chloride.

SPECIAL STUDIES AND DETAILED REPORTS - Detailed information including necessary precautionary measures have been secured and supplied to those directly concerned in the Esso Laboratories, the Medical Department and Safety

Department at Baton Rouge Refinery, upon the following subjects:

1. Vapor-Proof Flashlights
2. Safe Heating Units
3. Determination of Formic Acid in Urine
4. Measures for Safeguarding the Sampling and Handling of KETENE and various Intermediate Products.
5. Suggestions for Construction of New Lead-Blending Room in Connection with Esso Laboratories.
6. Periodic Inspections of Equipment in Fischer Synthesis Pilot Oporations.
7. One-Way Lock for Door of X-Ray Laboratory to Prevent Leakage of Harmful Rays and Exposure to Workers.
8. OCTYL ALCOHOLS and DIOCTYL PHTHALATE.
9. K-Pilot Plant Precautionary Measures.
10. Precautionary Measures for Safeguarding the Use of Liquid Envelope For Protection of Stoncilling on Drums for Export Service.
11. Physiological Effects of Ultrasonic Radiations in Connection with Production of Catalyst Gel.
12. Properties and Probable Physiological Effects of ALKYL ALUMINUM CHLORIDES.
13. Physiological Effects of ZIRCONIUM TETRACHLORIDE.
14. "DAXAD-11" -- Properties and Probable Physiological Effects.
15. Physiological Effects of BROMINATED COMPOUNDS.
16. Physiological Effects of C_8 to C_{10} ALDEHYDES.
17. Physiological Effects and Suggested Precautionary Measures for Safeguarding the Handling of BROMINE.
18. Safeguarding the Handling of OCTYL ALCOHOLS.

19. Physiological Effects of ISOPHORONE.
20. Physiological Effects of DIOCTYL PHTHALATE.
21. Physiological Effects of BUTYRIC and ISOBUTYRIC ACIDS.
22. Physiological Effects of AGERITE STALITE.
23. BORON TRIFLUORIDE : Its Toxicity and Some Precautionary Measures for its Use and Handling.
24. Physiological Effects of DI-CYCLOPENTADIENE.
25. Physiological Effects of DIVINYLBENZENE.
26. Explosive Properties of Activated Carbon Powder.
27. Physiological Effects of BERYLLIUM SALTS.
28. Determination of Small Concentrations of OZONE in Working Atmospheres.
29. Oil-Shale and Shale Oils: Their Physiological Effects and Precautionary Measures for Safeguarding Their Handling.
30. Physiological Effects of COBALT CARBONYL.
31. Precautionary Measures for Safeguarding Use of Mercury Boilers.
32. Physiological Effects and Precautionary Measures for Handling COBALT, Finely-Divided COBALT, and COBALT CARBONYLS.
33. BORON TRICHLORIDE : Its properties, Physiological Effects and Suggested Precautionary Measures.
34. PERCHLOROMETHYLMERCAPTAN : Properties and Physiological Response.
35. Toxicity and Physiological Effects of C_4 to C_{12} ALDEHYDES.
36. Physiological Effects of COBALT NAPHTHENATE.

37. Physiological Effects and Precautionary Measures for 1,4 DIOXANE.

38. Hazards and Precautionary Measures to Safeguard the Handling of SODIUM PASTE.

39. Determination of COBALT CARBONYL.

40. Liquid Soap Dispensers.

41. Dish-Washing Equipment and Dish-Washing Techniques.

R.S. Bonsib, E.M.
April 12, 1949

SUMMARY OF PLANT INDUSTRIAL HYGIENE PROBLEMS STANDARD OIL COMPANY (N.J.)

N. V. Hendricks, M.S.

Mr. J. W. Hammond has pointed out certain problems existing in the Humble Oil & Refining Company and has indicated the general nature of the Industrial Hygiene Survey which was made at the Baytown Refinery last year. In this connection I should like to emphasize one or two points concerning this survey. During the course of this study approximately seventy different operations and areas in the refinery were noted where detailed studies for the purpose of evaluating these specific exposures should be made. In order to illustrate the extent of this work; it is estimated that complete evaluation of these exposures will involve the collection and analysis of several hundred different samples. This will have to be followed by an analysis of the data thus obtained and later by the development of proper control procedures for the alleviation of the exposures.

Mr. T. F. Hatch has outlined certain broad principles which are basic to industrial hygiene. At this time I should like to point out a few things which have happened in the Company within the past year, due to the fact that these principles have not been applied. Within one unit of the Company two deaths occurred from exposures to carbon tetrachloride. It appears that a proper understanding of the behavior of this type material might have avoided this situation.

In another affiliate of the Company a group of workers were exposed to arsine gas which resulted in a certain number of deaths. Here again a study of the operations involving the arsinic compounds and a better understanding of these materials probably would have prevented this incident. From another affiliate we have received correspondence describing to us certain complaints on the part of various groups of workmen and giving to us

information covering the clinical picture of the individuals involved. We were asked to give an opinion as to whether or not these complaints were justified or not. In reviewing the details described to us, it was observed that the picture presented to us outlined classical pictures of lead poisoning, metal fume fever, and other occupational ills. The above points are mentioned to illustrate the fact that there are a great number of problems resulting from the impact of the working environment of the man and that these situations are not being recognized.

In many cases it is highly desirable to obtain information on certain exposures, although that information might be negative. As an example of this, one affiliate of the Company is currently involved in litigation over an exposure of clay dust which is alleged to have produced a certain type of pneumoconiosis followed by tuberculosis. A study of this plant and the job which this individual was doing indicates that the type dust in question probably is incapable of producing disabling lung pathology and, further, the levels of dust exposure were low and not in the order of magnitude which could be considered dangerous even for a dust carrying greater amounts of free silica. In a situation such as this, a record of dust counts over a period of years would be invaluable as evidence in combating unfounded claims for disability.

The problem of carcinogens within the Company has been fully discussed and I am sure that you are well acquainted with the various environmental aspects and the time which should be devoted to these problems by the Industrial Hygienist.

The matter of atmospheric pollution has been mentioned. This problem is indigenous to refinery operations and exists in several of the affiliate companies. There is currently a great deal of interest and activity in the

field of atmospheric pollution and Governmental agencies, including the U.S. Public Health Service, are considering this a matter of public health dimensions. Certainly there are both public health and medical implications associated with atmospheric pollution and the medical departments of industry of necessity inherit certain responsibilities. In order to illustrate the importance which atmospheric pollution at times may assume, I wish to bring to your attention two situations involving affiliates of the Company. One affiliate operating in a foreign area has been sued for One Million Dollars and has paid $250,000 in connection with the atmospheric pollution caused by their refinery. Another affiliate of the Company is currently considering locating a refinery in a foreign area. The local Government of this particular area has brought up the problem of what will be the extent of air pollution and wants to be assured that no problem will exist. In this situation the matter of atmospheric pollution may determine whether or not the refinery is located at the proposed site.

There are a number of problems within the Company which do not lend themselves readily to the usual field methods of investigation employed by Industrial Hygienists. These problems cannot be evaluated by the collection and analysis of samples as is normally done with many routine industrial hygiene problems. These particular situations can be approached only by statistical methods with the proper correlation of medical and employment records with the clinical findings on the exposed groups of workers. Problems of this kind are illustrated by the wax operations at Bayonne and Baton Rouge, the current investigation being carried out in the Chemical Products Division at Bayway, the workers who in the past have been exposed to carbon tetrachloride in operating the barasol plant at Baton Rouge, and others.

From time to time we are asked to assist in predicting the nature of certain problems which would develop from the use of toxic materials in certain Company products. In work of this kind we are called upon to calculate on a theoretical basis concentration levels of various compounds which could exist from the use of materials manufactured in various ways. Information of this type is at times helpful to certain people in evaluating and considering the inclusion of certain compounds in manufacturing procedures.

Currently there is a considerable amount of interest on the part of official Governmental groups towards the adoption of codes and regulations which would establish certain hygienic standards for industrial operations. The American Conference of Governmental Industrial Hygienists has recently prepared a proposed uniform Industrial Hygiene Code which they expect to serve as a guide for the various States. In preparing such rules and regulations for local adoption, it appears that, if and when such codes are adopted in the various States, from a legal standpoint the Company will be responsible for compliance with the various provisions. Therefore, it has been important for us to follow the progress of these codes and to study their contents with the thought in mind as to what implications might result from their adoption. Recently the Province of Quebec officially adopted such a code and industries in that area are now governed by the various provisions. This directly affects the Montreal Refinery of the Imperial Oil Company. From information which we have obtained concerning the Quebec Code, it appears that the local Government Agency responsible for the administration of this Code means business and that they expect industry in that Province to comply with the provisions.

To give you some idea as to the extent and type of these problems, I might say that during 1948 we advised eleven affiliate companies on approximately two-hundred-fifty separate problems. These came as requests for information and assistance and I believe have represented some of the problems

which were recognized. It further appears that these make up only a small portion of the actual problems in existence, as many such situations are not recognized and, as a result, no work is being done on them.

There is an urgent need for a closer coordination between the medical and engineering investigations on industrial hygiene problems. I do not think that this point can be over-emphasized. It cannot be assumed that industrial hygiene represents an engineering function alone, but on the other hand the fact must be accepted that proper investigation of environmental problems necessitates the team work of the physician and the engineer. This has not yet been done to any appreciable extent within the Company.

In summary I should say that some of the environmental problems have been recognized and have been studied in a fairly complete fashion. Many others have been recognized, but their study has been extremely incomplete and insufficient data were developed to permit indicated analysis of the problem. Although some of these problems have received attention, there are great areas of deficiency with respect to other problems concerning their existence, extent, and nature of control methods required. This applies not only to the mere existence of such problems, but goes into such considerations as toxicity, use of materials, groups of workers exposed, their clinical pictures and the like. I believe that it all adds up to the fact that we have ahead of us a tremendous amount of work which must be done.

N.V. Hendricks, M.S.
April 11, 1949