This Health Hazard Evaluation (HHE) report and any recommendations made herein are for the specific facility evaluated and may not be universally applicable. Any recommendations made are not to be considered as final statements of NIOSH policy or of any agency or individual involved. Additional HHE reports are available at http://www.cdc.gov/niosh/hhe/reports

HETA 97-0001-2643
S&B Engineers and Constructors, Ltd.
Sweeny, Texas

Max Kiefer, M.S., C.I.H.
Boris D. Lushniak, M.D., M.P.H.

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Max Kiefer, M.S., C.I.H., and Boris D. Lushniak, M.D., M.P.H., of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing by Kathy Mitchell and Patricia C. McGraw.

Copies of this report have been sent to employee and management representatives at S&B Engineers and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. Single copies will be available for a period of three years from the date of this report. To expedite your request, include a self-addressed mailing label along with your written request to:

NIOSH Publications Office
4676 Columbia Parkway
Cincinnati, Ohio 45226
800-356-4674

After this time, copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Health Hazard Evaluation Report 97-0001-2643
S&B Engineers and Constructors, Ltd.
Sweeny, Texas
June 1997

Max Kiefer, M.S., C.I.H.
Boris D. Lushniak, M.D., M.P.H.

SUMMARY

On October 10, 1996, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) from S&B Engineers employees working at the Phillips Sweeny Refinery in Old Ocean, Texas. The requestors asked NIOSH to determine if workplace exposures were related to skin problems experienced by some S&B employees working in Unit 12 (Ethylene) at the refinery.

On November 13-15, 1996, NIOSH investigators conducted a site visit at the Phillips Sweeny Complex. S&B investigation reports of the skin problems and material safety data sheets (MSDSs) for substances used or present in Unit 12 were reviewed and work practices were observed for several tasks. Industrial hygiene data collected by Phillips Safety and Health personnel in Unit 12 were reviewed, and materials suggested as possible contributors to the skin problems, including catalyst, refinery residue, and cooling tower chemicals were discussed with both Phillips and S&B personnel. Informal discussions were held on-site and off-site with both current and former S&B employees. Bulk samples of materials used in the gunnite operation, the calcium silicate-based insulation, and mortar were collected and analyzed. The medical component of the HHE included reviewing medical records in the possession of S&B for 46 workers; conducting private interviews and skin exams with 34 current S&B employees, 2 former employees, and 4 employees of subcontractors; reviewing the S&B Engineers Occupational Safety and Health Administration Log and Summary of Occupational Injuries and Illnesses (OSHA 200 log) for 1996; and reviewing S&B and physician-generated summary reports. Post-site visit activities included obtaining additional information regarding fire-resistant coveralls (FRCs), as some workers attributed their skin problems to the use of FRCs, and reviewing additional medical records.

Of the 34 current employees examined, 9 had an active skin process consistent with a contact dermatitis. No single clinical pattern of skin findings and distributions could be distinguished and these employees worked in a variety of jobs. Although a number of contaminants and activities were identified that could contribute to the skin problems, no specific environmental exposure was found that could account for most of the cases. The results of the bulk sample analyses did not identify any unexpected constituents or contaminants. Because conditions in the work area, work practices, and activities have reportedly changed considerably during the course of the Unit 12 renovation, it is difficult to assess the impact of past work practices on the reported skin problems.

A number of potential workplace environmental explanations for the dermatitis experienced by some S&B employees working in Unit 12 were identified during this evaluation. However, a single activity, contaminant, or event responsible for the skin problems was not identified. It appears that the most likely explanation includes multiple environmental factors, which may or may not be related. These factors include exposure to renovation activities and the materials used; the use of FRCs and subsequent laundering practices; exposure to spent catalyst or residual chemicals in Unit 12; and the use of certain soaps. Suggestions for future renovation activities, including reducing the potential for exposure to contaminants that could cause skin reactions, employee training, and additional workplace activity assessments, are provided in the Recommendations section of this report.

KEYWORDS: SIC 2911 (Petroleum Refining). Dermatitis, contact dermatitis, irritant contact dermatitis, allergic contact dermatitis, ethylene refinery, catalyst, fire-retardant clothing, contractors

TABLE OF CONTENTS

Preface ii

Acknowledgments and Availability of Report ii

Summary iii

Introduction 2

Background 2
- Facility Description 2
- Reported Skin Problems 2

Methods 3
- Industrial Hygiene 3
- Medical 3

Evaluation Criteria 4

Results 5
- Environmental 5
  - Fire-Resistant Clothing 6
  - Catalyst 6
  - Cooling tower mist 6
  - Renovation activities 6
  - Bulk Samples 7
  - Medical 7
  - Record Review 7
  - Interviews and Skin Examinations 7

Discussion 8

Conclusions 8

Recommendations 9

References 10

INTRODUCTION

On October 10, 1996, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) from S&B Engineers employees working at the Phillips Sweeny Refinery in Old Ocean, Texas. The request asked NIOSH to determine if workplace exposures are related to skin problems experienced by some S&B employees working in Unit 12 (Ethylene) at the refinery.

On November 13-15, 1996, investigators from NIOSH conducted a site visit at the Phillips Sweeny refinery. During the site visit, NIOSH investigators observed work practices, reviewed existing reports regarding the skin problems, interviewed employees, and collected bulk samples of construction materials. Industrial hygiene monitoring data collected by Phillips Safety and Health personnel in Unit 12 were reviewed, as well as material safety data sheets (MSDSs) and work procedures.

A letter describing the actions taken by NIOSH and reporting preliminary findings and recommendations, was issued to S&B Engineers management and employee requesters on December 19, 1996.

BACKGROUND

Facility Description

Unit 12 at the Phillips Sweeny Refinery is a 1950's vintage ethylene production unit that was taken out of service in 1990. In 1995, S&B Engineers was retained as the general contractor for the renovation of Unit 12, including repair and preparation for restarting the unit. Unit 12 encompasses an area approximately 300 yards by 600 yards. In March 1995, an initial inspection of the ethylene unit was conducted by S&B personnel. Following this inspection, an asbestos abatement contractor removed all asbestos insulation from the unit. When S&B began work in September 1995, the unit had been depressurized, all hydrocarbons removed, and the system flushed. All work was conducted under the direction of Phillips Corporate Engineering. Throughout the project (up to the time of the NIOSH visit), there had been approximately 450-500 S&B field personnel and 200-300 subcontract personnel working for 8 different subcontractors. Management and engineering staff are located on-site adjacent to the unit. There were approximately 1350 Phillips employees working at the Sweeny Refinery, but only 20-30 in the Unit 12 area. At the time of the NIOSH site visit there were 515 S&B employees (457 field/crafts personnel, 41 staff, 17 engineering), 266 sub-contractor employees, and approximately 110 scaffold builders working in Unit 12. S&B anticipated that the project would be completed by mid-January 1997.

Reported Skin Problems

Skin problems were first reported by S&B employees in late April or early May 1996 and continued to be reported through the summer and fall. As of November 13, 1996, 88 of the 515 S&B employees reported on a questionnaire provided by S&B contract physicians that they had experienced some type of skin problem since beginning work at Unit 12. However, no determination on the work-relatedness of these skin problems had been made. Discussions with S&B and Phillips health and safety personnel, including the Phillips occupational health nurse, indicated the skin problems were occurring only among S&B employees. No written reports of skin problems affecting subcontractors or Phillips employees were available. However, sub-contractor employees would not likely seek medical attention from the Phillips employee health center and would report any skin problems to their employer, not S&B Engineers or Phillips. According to reports, medical evaluations of some employees by local physicians had not identified an environmental cause for the reported skin problems. In June-July 1996, a consulting medical team, hired by S&B, conducted an investigation to determine if the skin problems were work-related and to identify any patterns or likely explanations. Efforts to match the reported cases with specific activities, laundry practices, clothing, did not identify any apparent associations.

Some workers, however, attributed their skin problems to the use of fire-resistant coveralls (FRCs). Actions taken to resolve the skin problems included offering alternative FRCs (different manufacturer and material composition) and providing recommendations for medical treatment. Hand washing facilities were available at the worksite and S&B had plans to install a laundry facility for the FRCs.

Another evaluation conducted by S&B contract physicians was ongoing at the time of the NIOSH site visit. These physicians were conducting examinations of S&B employees who had indicated on a questionnaire they had or were experiencing skin problems. The questionnaire had been developed by the S&B contract physicians and provided a few days prior to the NIOSH visit to all current S&B employees. Subsequently, on November 14, the questionnaire was provided to all subcontractors working in Unit 12.

METHODS

On November 13, an opening conference was held with representatives from Phillips Petroleum Company, S&B Engineers, and medical consultants working for S&B Engineers. Employee representatives were also in attendance. During this meeting, information about NIOSH was provided, and the HHE request was discussed. Following the opening conference, a walkthrough inspection of Unit 12 to review the work area and observe employee activities was conducted. Upon completion of the Unit 12 inspection, a meeting was held with S&B contract and Phillips physicians at the Phillips employee health center.

Industrial Hygiene

On November 14-15, S&B dermatitis investigation reports and material safety data sheets (MSDSs) for substances used or present in Unit 12 were reviewed. Work procedures were discussed with S&B and other contractor personnel. Work practices were observed for several tasks, including gunnite, insulation, abrasive-blasting preparation, and pipe-fitting. Industrial hygiene data collected by Phillips safety and health personnel in Unit 12 were reviewed, and materials suggested as contributors to the skin problems, including catalyst, refinery residue, and cooling tower chemicals were discussed with both Phillips and S&B personnel. Informal discussions were held on-site and off-site with both current and former S&B employees.

Bulk samples of materials used in the gunnite operation (Portland cement), the calcium silicate-based insulation, and mortar (One-Kote) were obtained. The bulk samples were shipped to the NIOSH contract laboratory (Data Chem, Salt Lake City, UT) and analyzed for 28 elements by inductively coupled emission spectrometry according to NIOSH Method 7300.[1] A portion of the insulation and mortar samples were sent to the NIOSH laboratory and analyzed via polarized light microscopy to identify fibers.

Medical

Medical activities during the site visit included the following:

1. Reviewing medical records in the possession of S&B for 46 workers who were previously evaluated for possible work-related skin problems.
2. Conducting voluntary, private interviews and (where indicated) skin exams with 34 current S&B employees and 4 employees of subcontractors, all identified to us by S&B. In addition, two former employees were also interviewed and examined.
3. Reviewing the S&B Engineers Occupational Safety and Health Administration Log and Summary of Occupational Injuries and Illnesses (OSHA 200 log) for 1996.
4. Reviewing S&B and physician-generated summary reports.

At the conclusion of the on-site investigation, a closing conference was held with management and employee representatives from S&B Engineers and Phillips to review our preliminary findings and recommendations. Post site-visit activities consisted

of obtaining information from FRC manufacturers regarding reports of allergic reactions associated with the use of this clothing, and obtaining additional information on selected materials identified during the site visit. Medical records for two workers who were evaluated by a private physician were reviewed.

EVALUATION CRITERIA

Because of the multiple diagnoses and the multiple exposures at this worksite, this discussion will emphasize a general overview of occupational skin diseases. In addition, because many workers had skin diagnoses related to a variety of forms of dermatitis, dermatitis will be emphasized here.

Occupational skin diseases can manifest themselves in a variety of ways. These include--contact dermatitis, which includes irritant contact dermatitis and allergic contact dermatitis, skin cancers, skin infections, skin injuries, and a large group of miscellaneous skin diseases [such as folliculitis/furuncles, acneiform dermatoses (chloracne), urticaria (systemic and contact), benign neoplasia, photodermatitis, pigmentary disorders, connective tissue disorders, climatic disorders (miliaria rubra/prickly heat, asteatotic eczema/winter eczema), granulomatous dermatoses, ulcerative lesions, alopecia, and discoloration of hair, skin, and nails.] Many references on occupational skin disorders are available.[2,3,4]

Not all skin diseases have an identified environmental or occupational cause. For many skin diseases the exact factors causing the disease are unknown (e.g., psoriasis, alopecia areata, rosacea, urticarial vasculitis). Some diseases such as contact dermatitis and contact urticaria are known to be caused by exposures in the work and/or non-work setting (e.g., contact dermatitis to household products, perfumes, creams). Other skin diseases may not be caused by these environmental exposures, but may be exacerbated by such exposures (e.g., lesions of psoriasis produced at sites of skin friction or injury, heat exacerbating rosacea, wet work initiating dyshidrotic eczema).

In general, the causes of occupational skin disorders can be grouped into the following categories:

1. Physical insults (friction, pressure, trauma, vibration, heat, cold, variations in humidity, ultraviolet/visible/infrared radiation, ionizing radiation, and electric current).
2. Biologic causes (plants, bacteria, fungi, protozoa, and arthropods).
3. Chemical insults (water, inorganic acids, alkalis, salts of heavy metals, aliphatic acids, aldehydes, alcohols, esters, hydrocarbons, solvents, metalloorganic compounds, lipids, aromatic and polycyclic compounds, resin monomers, and proteins).

Contact dermatitis is the most common occupational skin disease. Epidemiologic data show that contact dermatitis makes up 90-95% of all occupational skin diseases.[5,6,7] Contact dermatitis (both irritant and allergic) is an inflammatory skin condition caused by skin contact with an exogenous agent or agents, with or without a concurrent exposure to a contributory physical agent (e.g., ultraviolet light). It is widely accepted that of all contact dermatitis, 80% is due to a nonimmunologic reaction to chemical irritants (irritant contact dermatitis) and 20% to allergic reactions (allergic contact dermatitis). Only certain chemicals are allergens, and only a small proportion of people are susceptible to them. Complete reviews of both irritant and allergic contact dermatitis are available in other sources.[2,4,8,9]

In dermatitis, the skin initially turns red and can develop small, oozing blisters (vesicles), and bumps (papules). After several days, crusts and scales form. Stinging, burning, and itching may accompany the rash. With no further contact the rash usually disappears in one to three weeks. With chronic exposure, deep cracking (fissures), scaling, and discoloration of the skin (hyperpigmentation) can occur. Exposed areas of the skin, such as hands and forearms, which have the greatest contact with irritants or allergens, are most commonly affected. If the chemical gets on clothing, it can produce rashes at areas of greatest contact, such as thighs, upper back, armpits, and feet. Dusts can produce

rashes at areas where the dust accumulates and is held in contact with the skin, such as under the collar and belt line, at the tops of socks or shoes, and in flexural areas (e.g., front of the elbow, back of the knee). Mists can produce a dermatitis on the face and anterior neck. Irritants and allergens can be transferred to remote areas of the body (such as the trunk or genitalia) by unwashed hands or from areas of accumulation (such as under rings or in between fingers). It is often impossible to clinically distinguish irritant from allergic contact dermatitis, as both can have a similar appearance and both can be clinically evident as an acute, subacute, or chronic condition.

Extensive lists of irritants and allergens are available in reference books.[2,8] The most frequent causes of irritant contact dermatitis include soaps/detergents, fiberglass and particulate dusts, food products, cleaning agents, solvents, plastics and resins, petroleum products and lubricants, metals, and machine oils and coolants.[7,10] Causes of allergic contact dermatitis include metallic salts, organic dyes, plants, plastic resins, rubber additives, and germicides.[10]

The work-relatedness of skin diseases may be difficult to prove. The accuracy of the diagnosis is related to the skill level, experience, and knowledge of the medical professional who makes the diagnosis and confirms the relationship with a workplace exposure. Guidelines are available for assessing the work-relatedness of dermatitis,[11] but even with guidelines the diagnosis may be difficult. The diagnosis is based on the medical and occupational histories and physical findings. The importance of the patient's history of exposures and disease onset is clear. In irritant contact dermatitis there are no additional confirmatory tests. Patch tests or provocation tests are discouraged because of a high false-positive rate. In many instances, allergic contact dermatitis can be confirmed by skin patch tests using specific standardized allergens or, in some circumstances, by provocation tests with nonirritating dilutions of industrial contactants.[8]

Because people with contact dermatitis can develop long-term dermatologic problems, prevention is key. Strategies in the prevention of contact dermatitis include identifying allergens and irritants, substituting chemicals that are less irritating/allergenic, establishing engineering controls to reduce exposure, utilizing personal protective equipment (PPE) such as gloves and special clothing appropriately, emphasizing personal and occupational hygiene, establishing educational programs to increase awareness in the workplace, and providing health screening.[7,10,12] The introduction of PPE must be considered carefully since it may actually create problems by occluding allergens or irritants or by directly irritating the skin. Similarly, the excessive pursuit of personal hygiene in the workplace may actually lead to misuse of soaps and detergents, which can result in irritant contact dermatitis.[13] The effectiveness of gloves depends on the specific exposures and the types of gloves used. The effectiveness of barrier creams is controversial,[14] and at times workers using barrier creams may have higher prevalence rates of contact dermatitis compared to those who do not use the creams.[15]

RESULTS

Environmental

A review of MSDSs for materials used in the Unit 12 renovation project identified a number of compounds that could cause dermatitis if excessive exposure or product misuse were to occur. As there is a wide variety of chemicals that can adversely affect the skin, particularly at a construction site, this is not an unexpected finding. These materials include paints (some of which contain epoxy polymers and polyurethanes), metals, and a variety of solvents. Some sealants, hardeners, fiber-containing insulations, and mortars could adversely affect the skin under certain conditions. However, most of these materials were being used or applied by subcontractor employees.

Workplace observations, informal interviews with S&B and Phillips personnel, and a review of reports

from previous investigations indicated a number of environmental factors that may have contributed to the skin problems.

Fire-Resistant Clothing

Phillips Safety Policy required personnel working in the refinery to wear FRCs and two types were used by S&B Engineer employees. Initially, a full-body garment made of Nomex® was provided. Nomex® is made of aramid fibers, which is an aromatic polyamide formerly called nylon. Aromatic polyamide fibers have many of the desirable properties of nylon plus improved heat resistance and strength.[16] The garments are also treated with various materials to provide antistatic and lubricating properties, and color. According to the manufacturer the material has been in use for over 25 years and testing has shown that Nomex® fibers produce no skin irritation or sensitization.[17] However, the manufacturer has occasionally received reports of concerns about allergic or irritant reactions from people wearing Nomex®, usually involving new garments, and has developed a protocol of recommended actions that should be taken in the event skin reactions are reported.[18] Potential causes of skin problems include mechanical irritation or reactions to contaminants, laundry additives, pH extremes after a laundry procedure, or reaction to a finish or dye used on the fabric. According to the manufacturer, in recent years the use of FRCs has increased considerably, particularly in the petrochemical industry.[19]

After reports of skin irritation possibly associated with the use of FRCs, S&B Engineers provided an alternative garment (Indura®). This garment is made of 100% cotton that is treated with a flame resistant substance (phosphonium salt precondensate) that has the potential to release formaldehyde.[20] Formaldehyde is a known irritant and sensitizer, and dermal sensitization to formaldehyde following skin contact is well documented.[21] According to the manufacturer's product information, however, the formaldehyde content is very low following the chemical treatment process.[20] Indura® garments have been on the market for approximately 20 years. The manufacturer reports that approximately 10 complaints of dermatitis are received each year, and they have developed an action plan for responding to these complaints which is similar to that instituted by the Nomex® manufacturer.[22]
Phillips personnel indicated there have been anecdotal reports of skin problems resulting from the use of this clothing in the refinery industry.

Catalyst

On May 23, 1996, an incident involving a release of spent catalyst (dust consisting of aluminum oxide, silicon dioxide, trace metals) occurred at Unit 3. The release affected the Unit 12 work area, necessitating emergency cleanup actions. Some of the affected S&B employees attributed their skin problems to this event, although for others the skin problems had been reported prior to the May 23 release. There have also been other less significant releases of catalyst that may have affected the Unit 12 area. The Phillips MSDS for spent catalyst states that skin irritation may occur with prolonged contact and that allergic reactions may develop.

Cooling tower mist

Personnel working in Unit 12 are routinely exposed to mist from large cooling towers located adjacent to the work area. According to Phillips personnel, the pH of the cooling water is normally 8-8.5 (slightly alkaline). Treatment chemicals added to the cooling tower include zinc chloride, phosphoric acid, dispersants (sulfonated polyacrylate), chlorine, and soda ash.

Renovation activities

The density of workers in the Unit 12 area was very high and workers were conducting a variety of activities in close proximity to each other. Many of these activities produced dust or other contaminants (e.g., pipe and tank insulation, sand-blasting, gunnite

application with Portland cement, painting).

A review of the environmental monitoring data collected by Phillips personnel did not identify any unusual contaminants or excessive concentrations of hydrocarbons or insulation materials. Air samples collected by Phillips personnel on June 30, 1996, in response to a recent spent catalyst release found low concentrations of particulate, and less than detectable levels of nickel, antimony, and cadmium.

Bulk Samples

Microscopic examination of the thermal insulation found all fibers to be cellulose, while the One-Kote (cementitious insulation used as mortar) contained both fibrous glass and cellulose fibers. Prolonged contact with fibrous glass can result in skin irritation. Elemental analysis of the Portland cement and the insulation material found low concentrations of arsenic (31 micrograms per gram) and nickel (15 micrograms per gram) in the One-Kote insulation mortar. One possible source of these elements is fly ash, a component in the mortar. Approximately 190 micrograms per gram of chromium was detected in the Portland cement. Chromium is commonly found in Portland cement.

Medical

Record Review

Medical records in the possession of S&B for 46 workers who were evaluated for possible work-related skin problems were reviewed. Diagnoses noted by several local physicians included nonspecific rashes / dermatitis / exanthems (19 workers), contact dermatitis (18), fungal infections (5), diseases of the hair or sweat glands (3), and bacterial skin infection (1). These workers came from a variety of locations within Unit 12 and included a variety of job titles. The possible causes of the skin conditions were not listed in any of the records.

The S&B Engineers OSHA 200 log for 1996 was reviewed. The OSHA 200 log did not provide any additional information regarding skin problems in the workforce. S&B summary reports were also reviewed. These were synopses prepared by S&B of the 46 S&B medical records and did not provide further information as to the etiology of the skin problems. Finally, a summary report written by the S&B consulting medical team was reviewed. This report noted possible contributing factors for skin conditions in nine workers examined in July 1996; these included sweating, rubbing, scratching, possible clothing dermatitis or exacerbation by clothing, and improper self-treatment of the skin problems. The consulting medical team did not see any patterns to associate location of work areas or type of work with skin problems.

Medical records for two workers from a private physician were reviewed. These records did not provide additional information regarding skin problems in these individuals or in the workforce.

Interviews and Skin Examinations

Of the 34 current employees examined, 9 had an active skin process consistent with a contact dermatitis. Parts of the body affected included legs (2 workers), feet (2), and (1 worker each) finger, hand, forearm, face, and neck/face/arm. No single clinical pattern of skin manifestations could be discerned and these employees worked in a variety of jobs (3 were electricians, 3 were electrician helpers, and 3 were boilermakers). Time since being hired at this job site ranged from 1 to 13 months. Onset of the skin problems began at different time periods (2 each in May, September, and November of 1996, and 1 each in July, August, and October of 1996). Time period between month of hire and development of skin problems also varied--3 workers developed dermatitis 2 months after being hired, 2 within a month, and one each of 1 month, 4 months, 5 months, and 13 months after being hired.

Of the other workers examined, 13 appeared to have conditions not usually associated with workplace exposures (7 with fungal diseases, 1 each with eczema, porphyria cutanea tarda, pruritus, sun-

induced skin damage, follicultis, and keratosis pilaris), and 12 workers had resolved or resolving skin conditions that could not be clinically evaluated as to work-relatedness. Of these 12, 9 described a skin condition that was, by history, most consistent with contact dermatitis. Both former workers examined and the 4 subcontractor employees had resolving conditions that could not be clinically evaluated as to work-relatedness.

It must be emphasized that the preliminary diagnoses are based upon a single interview and examination. Skin diseases may be difficult to diagnose. The cause of the skin disease, and its work-relatedness, are even harder to establish. The above list should not be interpreted as the definitive individual diagnoses; further medical workup and follow-up of the affected individuals would be necessary for that.

Based on employee interviews, there seems to be a high level of anxiety among S&B employees regarding the occurrence of skin problems. Some of this anxiety is likely due to uncertainty about the cause(s) of the skin problems, widespread speculation and rumors that have not been adequately investigated, and a lack of information about potential exposures. The results of environmental monitoring and previous investigations have not been effectively communicated.

DISCUSSION

No specific contaminants or activities responsible for the reported skin problems were identified by the NIOSH investigators. A previous NIOSH health hazard evaluation of skin rash and irritation among refinery workers at a cracking unit failed to identify a specific agent responsible for the skin problems, but the investigators concluded that catalyst dust may have contributed to some of the dermatitis cases.[23] Although some employees attributed their skin problems to a catalyst release on May 23, 1996, other S&B employees' skin problems had been reported prior to the May 23 release.

Exposure to effluent from the cooling tower was considered by S&B a potential explanation for some of the dermatitis cases. However, this is not considered a likely source as refinery personnel in areas other than Unit 12 are also exposed to cooling tower mist, and there were no reports of dermatitis in these other areas. Additionally, if cooling tower mist were a significant factor, mucous membrane effects (e.g., irritation) from exposure to an airborne irritant would also be expected.

Other materials present in Unit 12, such as urethane-based paints, insulation materials containing ceramic or mineral fibers, abrasive blasting, and mortar, could also cause adverse skin effects. For example, Portland cement is an irritant and can cause dermatitis if repeated and prolonged skin contact occurs. The dermatitis may be complicated in some cases by the development of an allergic contact sensitivity to hexavalent chromium, which may be present in the cement. Dermatitis has been associated with both the chromium content of Portland cement and the alkalinity of wet cement.[24,25] Most of these materials, however, were being used or applied by subcontractors, and not S&B personnel. Many of the activities in Unit 12 generated considerable amounts of dust (e.g., abrasive blasting, insulation work, etc.). High dust levels could exacerbate existing skin conditions.

Other factors that could contribute to worker skin problems include the use of certain soaps or cleansers, inadequate laundering of work clothing, reactions to FRCs, and exposure to residual chemicals in Unit 12.

CONCLUSIONS

There are a number of potential workplace environmental explanations for the skin problems experienced by some S&B employees. It does not appear that a single activity, contaminant, or event is responsible for most cases; a more likely scenario includes multiple environmental factors, which may or may not be related. In addition to the renovation activities and the materials used, other potential

factors include the use of FRCs and subsequent laundering practices; exposure to spent catalyst or residual chemicals in Unit 12; and the use of certain soaps.

The response by S&B Engineers to this situation appeared to be appropriate. Medical evaluations of affected personnel were sought, and changes initiated in response to the medical findings.

Conditions in the work area, work practices, and activities have reportedly changed considerably during the course of the Unit 12 renovation. It is difficult to assess the impact of past work practices on the reported skin problems.

RECOMMENDATIONS

Because S&B Engineers is a contract firm with finite time frames for completing projects, the recommendations made as a result of this evaluation are general and intended for future work sites.

1. Increase efforts to keep employees informed of actions being taken to respond to employee health problems. Such actions may include: laundry changes, medical investigations, providing new clothes, etc.

2. Facility personnel at the contract site should provide information on relevant environmental monitoring and interpretation of results to S&B. This could be incorporated into the contractor hazard communication training. For example, at the Phillips Unit 12 site, the potential for adverse health effects from catalyst releases had not been adequately explained to the workforce.

3. Tasks utilizing materials that could cause adverse skin reactions should be assessed to ensure work is conducted in a safe manner. This includes assessing the impact on ancillary employees in close proximity to these tasks. These activities may include: painting, insulation (hot and cold pipe), grout/mortar installation, gunnite use, and abrasive blasting.

4. Efforts to reduce dust generation during gunnite use, abrasive blasting, and insulation activities should be undertaken. Controls that may be effective include additional barricades and shielding and work scheduling changes.

5. In general, a combination of the following strategies should be used to prevent occupational skin diseases at worksites:

a) identifying irritants and allergens in the workplace.
b) When feasible, and considering systemic as well as dermatologic toxicity, substituting chemicals that are less irritating/allergenic.
c) Establishing engineering controls to reduce skin exposure.
d) Utilizing personal protective equipment (PPE) such as gloves and special clothing (item 6 below).
e) Emphasizing personal and occupational hygiene (items 7 and 8 below).
f) Establishing educational programs to increase employee awareness of irritants and allergens in the workplace.
g) Providing a system for the evaluation, reporting, and surveillance of dermatologic diseases (item 10 below).

6. Skin should be protected from contact with irritants and allergens (sensitizers) with proper PPE such as clean gloves, protective coveralls, and sleeve protectors. Glove selection should be based on information in the specific MSDSs and other guidelines.[26] In the processes where contact with liquids occur, the practice of using cotton gloves should be discontinued or modified. Cotton gloves only serve to absorb liquids and wick potential irritants onto the skin surface. If the dexterity of an outer cotton glove is beneficial to the worker, then the skin should be protected with an inner layer of an appropriate impervious glove (such as polyethylene, nitrile, polyvinyl chloride, neoprene, or polyvinyl

alcohol, as appropriate). A thin cotton glove beneath the impervious glove may be helpful to wick away sweat buildup. However, special attention must be directed to assuring that the inner glove does not become saturated with liquid contaminants.

7. Irritants and allergens that have come in contact with exposed skin should be washed off with soap and water as soon as possible. Residual soap should be washed off the skin surface. Special attention should be directed toward soaps and skin cleansers since they themselves can serve as irritants. Certain components of the soaps or moisturizers (e.g., lanolin and fragrances) are known allergens and may cause allergic contact dermatitis in sensitive individuals.

8. Clothing contaminated with irritants or allergens should be removed and laundered prior to re-use.

9. Topical creams, ointments, and lotions containing neomycin sulfate, a common antibiotic, should be used with caution since neomycin is a potent skin sensitizer.

10. Workers should be encouraged to report all potential work-related skin problems. These should be investigated on an individual basis by the company or consulting health care providers. Because the work-relatedness of skin diseases may be difficult to prove, each person with possible work-related skin problems needs to be fully evaluated by a physician, preferably one familiar with occupational/dermatological conditions. A complete evaluation would include a full medical and occupational history, a medical exam, a review of exposures, possibly diagnostic tests (such as skin patch tests to detect causes of allergic contact dermatitis), and complete follow-up to note the progress of the affected worker. Individuals with definite or possible occupational skin diseases should be protected from exposures to presumed causes or exacerbators of the disease. In some cases of allergic contact dermatitis, workers may have to be reassigned to areas where exposure is minimized or nonexistent.

REFERENCES

1. NIOSH [1994]. Elements, method #7300. In: NIOSH manual of analytical methods, 4th ed. Eller, RM, ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-113.

2. Adams RM [1990]. Occupational Skin Disease, ed 2. Philadelphia, WB Saunders.

3. Hogan DJ [1994]. Occupational Skin Disorders. New York, Igaku-Shoin.

4. Marks JG, DeLeo VA [1992]. Contact and Occupational Dermatology. St. Louis, Mosby Year Book.

5. Fregert S [1975]. Occupational dermatitis in a ten-year material (sic). Contact Dermatitis 1:96-107.

6. Keil JE, Shmunes E [1983]. The epidemiology of work-related skin disease in South Carolina. Arch Dermatol 119:650-654.

7. Mathias CGT [1988]. Occupational dermatoses. J Am Acad Dermatol 6:1107-1114.

8. Fisher AA [1986]. Contact Dermatitis, ed 3. Philadelphia, Lea and Febiger.

9. Rycroft RJG, Menne T, Frosch PJ, et al, (eds) [1992]. Textbook of Contact Dermatitis. New York, Springer-Verlag.

10. Mathias CGT [1990]. Prevention of occupational contact dermatitis. J Am Acad Dermatol 23:742-748.

11. Mathias CGT [1989]. Contact dermatitis and workers' compensation - Criteria for establishing occupational causation and aggravation. J Am Acad Dermatol 20:842-848.

12. National Institute for Occupational Safety and Health (NIOSH) [1988]. Proposed national strategy for the prevention of leading work-related diseases and injuries - Dermatological conditions. Cincinnati, US Department of Health and Human Services, DHHS Publication (NIOSH) 89-136.

13. Mathias CGT [1986]. Contact dermatitis from use or misuse of soaps, detergents, and cleansers in the workplace. In Occupational Skin Disease: State of the Art Reviews - Occupational Medicine. Philadelphia, Hanley and Belfus.

14. Orchard S [1984]. Barrier creams. Dermatol Clin 2:619-629.

15. Varigos GA, Dunt DR [1981]. Occupational dermatitis - An epidemiological study in the rubber and cement industries. Contact Dermatitis 7:105-110.

16. Clayton GD, Clayton FE [1994]. Patty's Industrial Hygiene and Toxicology. Vol 2E Toxicology, 4th Ed. New York: John Wiley & Sons.

17. DuPont [1992]. Nomex aramid fiber products. Material Safety Data Sheet. DuPont Company, Wilmington, DE.

18. DuPont. Recommendations for handling reports of skin sensitivity while wearing a garment of Nomex® brand fiber. DuPont Company,Kevlar/Nomex/Teflon/Composit e Inquiry Center. Wilmington, DE.

19. Merryman T [1997]. Telephone conversation on January 7, 1997, between T. Merryman, Product Steward, DuPont Fibers and Fabrics, and M. Kiefer, Division of Surveillance, Hazard Evaluations, and Field Studies (Atlanta, GA), National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, U.S. Public Health Service, U.S. Department of Health and Human Services.

20. Westex Inc.[1992]. Indura treated fabrics. Material Safety Data Sheet. Westex, Inc. Chicago, IL.

21. Hathaway GJ, Proctor NH, Hughes JP, Fischman MF [1991]. Chemical hazards of the workplace, 3rd. Ed. New York: Van Nostrand Reinhold Company.

22. Baitinger B [1996]. Telephone conversation on December 5, 1996, between B. Baitinger, Vice-President, Technical Director, Westex Inc., and M. Kiefer, Division of Surveillance, Hazard Evaluations, and Field Studies (Atlanta, GA), National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, U.S. Public Health Service, U.S. Department of Health and Human Services.

23. NIOSH [1984]. Health hazard evaluation report: ARCO Philadelphia Refinery, Philadelphia, PA. U.S. Department of Health and Human Services, U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH Report No. HETA-83-248-1515.

24. Denton D, Keenan R, Birmingham D [1954]. The chromium content of cement and its significance in cement dermatitis. Jrnl. Inv. Derm. 23: 189-192.

25. Tosti A, Peluso A, Varotti C [1989]. Skin burns due to transit-mixed portland cement. Contact Dermatitis. 21(1):58.

26. Forsberg K, Mansdorf S [1993]. Quick selection guide to chemical protective clothing. 2nd. ed. Van Nostrand Reinhold. New York, NY.