

COOLANTS AND SKIN - OUR EXPERIENCE

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INTRODUCTION: Bharat Heavy Electricals Limited High Pressure Boiler Plant unit at Triuchi is a specialised unit for the manufacture of steam generators. The manufacture inside the factory are divided into three groups.

1. Boiler fabricating works.
2. Machine Shop for tools, fixtures and standard machine components.
3. Production and testing of valves and fittings.

The main boiler fabricating works include the drums and pressure vessels shop, cold and hot pipe shops, heavy machine shop, fabrication shop, ductings, mechanical and electrostatic ash precipitators. Some of the majore equipments installed in the factory are plate bending polls, electro-slag welding equipment, heat-treatment facility, hot and cold pipe bending machines and special welding machines.

PREVALENCE : In all industrial countries the prevalence of occupational dermatoses is high. In great Britain it accounts for most of the total annual injury benefit. Incapacity from this cause represents so much lost time and waste of health and money, for occupational dermatitis is largely preventable. Anytime a survey is made in factories of U.S.A. more than 1% of all the workers have occupational dermatoses. It is well known that cutting oils and lubricants produce dermatitis not because they are more powerful skin irritants than other chemicals but because more workers are exposed to their action for more number of years. With the above facts in mind, BHEL-OFS launched an occupational dermatoses survey.

In total 4921 workers are employed in various operations mentioned above. Following random sampling technique, drawn from various (production and maintenance) departments in all 1986 employees were screened. In the course of the study one entity that has emerged as of occupational origin, the prevalence of which is found to be high in oil folliculitis. 186 were found to be affected with occupational dermatoses. Out of which 142 were suffering from oil folliculiti . The rest of the cases fell into the following categories.

- a) Eczema of hands (in those employed in electroplating section handling trichlor ethylene).
- b) Melanoderma on cheeks, erythema with peeling of skin in front of chest and forearms in the welders.

ANNEXURE

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DISCUSSION ON OIL FOLLICULITIS: Oil folliculitis is a known entity in any industry involving a lot of machining, burning, mechanical maintenance and overhauling work. It is no surprise that our study revealed a high incidence of oil folliculitis. Constant exposure to irritant like oils is said to be one of the major factors responsible for oil folliculitis.

SKIN DEFENCE AGAINST CHEMICAL AND PHYSICAL AGENTS: Skin provides a protection against noxious agents from outside and this is one of its primary physiological functions.

- a) The surface film: The first line of defence is the film of sebum emulsified with sweat and breakdown products from the horny layer. The surface film, called the acid melt because its pH is on the acid side (4.2 - 5.6) can neutralize small amounts of alkali. The buffer capacity of the surface films varies considerably from one person to another and also from one body region to another.
- b) Stratum Corneum mainly composed of dead, keratinized cell contributes to the protective functions of the skin. The flexibility and cohesion of the horny layer depend on its water content, which is maintained by hygroscopic properties of water soluble residues of nuclear and cytoplasmic substances. The cell wall of the keratin layer constitutes a lipid-containing semi-permeable membrane that encloses the water soluble substances as in an envelope. The water holding substances are protected by the cell wall lipids. After removal of lipids, subsequent immersion in water for 2 minutes will remove as much of the water soluble substances from the Keratin layer as a 2 hr. immersion in water not preceded by defatting.

BREAK DOWN OF NATURAL RESISTANCE: A break-down of the natural resistance of the skin leads to increased permeability. This has an influence on percutaneous absorption.

- a) Occlusion promotes percutaneous absorption. Water is imbibed by the Keratin after prolonged immersion in water. It is of practical importance that rubber and plastic gloves, wrist-watch straps, rings, dress protectors, waterproof adhesives shoes, clothes and folds of the skin provide such an occlusion.
- b) Alkaline: solutions have a deleterious action on the horny layer and promote percutaneous absorption. This happens as a result of break in the crosslinks, of Keratin present in the form of disulphide links and hydrogen bonds.
- c) Inflammatory changes: In the epidermis facilitates the percutaneous absorption thus a primary irritant dermatitis can promote penetration of allergens and conversely an allergic contact dermatitis the penetration of primary irritants.

Appendages:- Fat soluble, noxious chemicals can be absorbed through the sebaceous glands and epithelium of the follicular root sheath. Thus, many substances can cause allergic and cause allergic and non-specific inflammation in the deeper part of the skin with an undamaged horny layer. Per-cutaneous absorption is slower on palms and soles than other parts of the skin. This is probably due to the thickness of the horny layer, to the presence of stratum lucidum, and to the absence of hair follicles. Absorption through sweat ducts and glands is not fully evaluated.

Chemistry of Cutting oils:

These are used in the industries.

1. As a coolant.
2. Carrier of the particles.
3. Lubrication between the tool and job.

Chemical composition.

Basically these are derivatives of aliphatic hydrocarbons. Aliphatic Hydrocarbons are compounds of Carbon and Hydrogen. They may be

1. Paraffins (Saturated Hydrocarbons)
2. Olefins (Unsaturated Hydrocarbons)

The aliphatic hydrocarbons of industrial importance are derived from Petroleum, which is a complex mixture of hydrocarbons. The saturated aliphatic hydrocarbons are used in industry as fuels, lubricants, solvents etc.

Halogenated hydrocarbons are derivatives of methane ethane and other hydrocarbons in which one or more of the Hydrogen atoms have been replaced by atoms of Fluorine, Chlorine or Iodine. Their solvent properties are similar to those of saturated hydrocarbons but they are potent skin irritants.

Cutting oils available as:-

1. Alkaline solutions-Milk alkaline compounds mixed with water-generally used in grinding operations.
2. Straight mineal oils.
3. Fatty oils.
4. Sulphurized and chlorinated oils.
5. Soluble cutting oils(Coolants) : They are mineral oils with emulsifying material and available in different proportions with water according to nature of work and used mostly for cooling. So known as Coolants.

IRRITANT DERMATITIS.

Action of Irritants: An irritant is a substance that in most people is capable of producing cell damage if applied for a sufficient time and in a sufficient concentration. Any chemical penetrates the skin and some molecules alter the skin cells. Dermatitis results is these cells are not repaired. Many irritants induce damage by gradually exhausting the horny layer, denaturing the keratin, and altering the water-holding capacity i.e. physio chemical damage. This increases the possibility of later biological damage to the living cells of the epidermis. Some persons are very easily irritated by many substances and some are easily irritated by only one group of substance although they tolerate others.

Two Types of Irritant Dermatitis:-

1. Acute irritant Dermatitis: This is alicited by strong irritants after a single applications or a few brief applications.
2. Dermatitis from Cumulative Insults: Dermatitis may develop after repeated insults by weak irritants over a long period. The aetiological factors are complex. If the skin is exposed for a long time to harmful agents, the possibility increases that the sum total of these effects will be sufficient to induce a dermatitis. Lowering of skin resistance may be the perpetuating cause.

PREDISPOSING FACTORS

- a) Age: Young workers usually because they are new on the job.
- b) Season: Summer frequently because of more perspiration. Excessive sweat macerates the skin and makes it vulnerable for the action of irritants.
- c) Uncleanliness: Uncleanliness of the working environment exposes the workers to large doses of external irritants. Personal uncleanliness not only does same but also permits the external irritants to remain in prolonged contact with the skin.

PATHOGENESIS OF OIL FOLLICULITIS. The coolant, which is a liquid paraffin hydro-carbon is a good fat solvent and by its cumulative insulting action on the skin produce oil folliculitis.

PROCESSES INVOLVED ARE AS FOLLOWS:

1. Chemical damage:

- a) By dissolving the sebum covering the skin.
- b) By exhausting the horny layer, denaturing the keratin and altering the water holding capacity of the skin.
- c) By enhancing the percutaneous absorption and dryness.
- d) Being fat soluble it is absorbed through the sebaceous glands and follicular root sheath and reaches the deeper parts of the skin and causing non-specific inflammation.

2. Biological damage: To the epidermis accompanied by a dermal reaction.

3. Changes such as sweat retention and alterations in the superficial bacterial flora may add to the process.

DIAGNOSIS:

- 1. History: Dermatitis developing during period of industrial exposure.
- 2. Site : On exposed parts where the contact is maximum e.g. forearms and the areas which are in contact with soiled clothes e.g. thighs.
- 3. Morphology of the lesion: Whether comedones or acneform lesions or folliculitis.
- 4. Patch Test: Patch testing is employed to diagnose contact dermatitis and to determine the causative chemical irritant.

We have not done patch testing in our study for the following reasons:-

- a) The fact that coolants producing oil folliculitis is well established.
- b) As many of the employees were having active lesions during screening it was deferred.

Remedial measures and corrective action taken:-

1. Personal Hygiene.

Employees were impressed upon about personal cleanliness.

2. Use of Barrier Cream: Barrier cream is considered to be sebum which helps the skin in lubrication. It is very effective against oil acne and folliculitis. It is available in water soluble base and water repellent base.

Both the types are difficult to be washed off. A good lot of the cream applied goes into the horny layer of skin. Sometimes it fails to protect the skin, as the cream that occupies the interstices between the horny cells does not protect the skin. Both the above factors were impressed upon the workers by health education at individual and group levels.

Coolants and health safety:

The need to maintain all the cutting fluid equipment in a clean and serviceable condition cannot be over-stressed and users must be made aware of the dangers that can be encountered from careless and in different handling.

Factors influencing Microbial growth:-

- a) Inclusion of swarf and rust in the system.
- b) Stagnation in the tanks of the used (cutting oil) coolant.

Adverse effects of Microbial growth:

- a) Biological degradation of coolants emanates bad odour.
- b) Chemical changes that affect the lubricating properties and viscosity of coolants.
- c) High microbial activity can be responsible for poor surface finish, decreased tool life, rapid corrosion after machining.

FOLLOWING STEPS ARE SUGGESTED TO OVERCOME THE ADVERSE EFFECTS ON COOLANTS.

1. Prompt removal of swarf from the coolant is essential.
2. Storage tanks should readily be accessible to facilitate cleaning thoroughly and regularly.
3. Stagnation helps bacterial growth and hence disturbing the whole volume of the coolant with a stirrer can be thought of. Another method will be as follows:-
The air above the coolant surface inside the tank is sucked, allowed to pass over an activated charcoal bed and then let off into atmosphere. Charcoal absorbs all the gaseous pollutants. A bed of 3' x 4' with half an inch layer of charcoal can be used for ten tanks. An air flow rate of 60 to 100 ft/mt is to be maintained.
4. Addition of germicide was thought of to have a control of bacteria. An experiment with pine oil as a germicide was carried out. It was found that 0.5% concentration of pine oil can keep the coolant less bad smelling for 3 weeks.
5. If coolant has to be returned to the machine tools for reuse, it is recommended that it can be subjected to a reclamation process such as pasteurisation to remove the contaminants. Pasteurisation is a process in which a general pool of coolant is created and the coolant is heated approx. upto 75°C thus killing all the germs. This heating is to be done as the coolant is allowed to pass through a constricted space at a particular rate of flow.

CONCLUSION:

1. Oil folliculitis is the result of constant exposure of workers of irritants like coolants for long number of years. In our study the minimum number of years required to produce folliculitis is 5 years.
2. Our experience: Poor concentration of personal cleanliness, unawareness of the protective nature of the Barrier Cream, patronising bacterial growth in coolant tanks and re-using the same are the promoting factors to produce oil folliculitis.

3. SUGGESTIONS:

1. Health education of employees stressing the importance of personal cleanliness and the use of barrier cream at individual and group levels. Use of aprons will help to protect the clothes getting soaked by coolants.
2. As a follow-up measure-constant supervision.
3. Pasteurisation of coolants before re-use.
4. Adding germicide like Pine Oil 0.5% concentration to combat the odour.
5. Sucking the air above the coolant tank and allowing it to pass through an activated charcoal bed.

We would like to share your experience.

I thank BHEL Organisation for providing me an opportunity and encouragement to conduct this survey. I am grateful to Dr. Sadanandamurthy and Mr. Narayanan for this Valuable suggestion.

- REFERENCE:
1. KERODEX BULLETIN.
 2. SWARF AND MACHINE TOOLS - P.J.G.GOUGH.
 3. ARTHUR ROOK.

TABLE I

Department	No. of Employees	No. of Employees who are exposed to the risk.	Number of Employees Examined	Number of cases with Occupational Dermatoses.	Number of cases with oil folliculitis Only.
VPN	500	472	327	50	40
MSTR	434	420	315	65	59
BPN	2326	2044	723	44	23
MMD	298	157	190	12	10
ELECTRICAL	284	215	120	7	4
C & S	152	125	90	4	2
TRANSPORT	285	84	130	2	2
CRANES	642	598	71	2	2
T O T A L	4921	4155	1986	186	142

CLASSIFICATION OF WORKERS WITH OIL FOLLICULITIS AND OTHER
(OCCUPATIONAL) SKIN DISEASES- DEPARTMENTWISE

TABLE II

Department	Workers with oil folliculitis.	Workers with other occupational skin diseases.	Total
VPN	40	10	50
MSIR	59	6	65
EPN	23	21	44
MNO	10	2	12
ELECTRICAL	4	3	7
TRANSPORT	2	-	2
C & S	2	2	4
CRANES	2	-	2
TOTAL	142 (76%)	44 (24%)	186

TABLE III

DEPARTMENT	Number of Employees Exposed to Coolants	Number of cases with oil Folliculitis	Percentage of workers with oil folliculitis	Range of dilution of coolants.
MSTR	349	59	17	1 in 40 to 1 in 20
VPN	289	40	14	1 in 30 to 1 in 20
BPN	342	23	7	1 in 60 to 1 in 20
MMO	40	10	25	1 in 30 to 1 in 60

This chart shows that the strength of coolants does not influence the incidence of oil folliculitis.

ESTIMATED NO. OF CASES IN EACH DEPARTMENT ON THE
BASIS OF THE PREVALENCE OBTAINED

TABLE IV

Department	Total Examined in each Dept.	Found with oil folliculitis	Prevalence per 1000 workers.	Total Employees in each Dept.	Estimated No. of cases in each Department.
MSTR	315	59	137	434	63
VPN	347	40	112	500	56
BPN	723	23	31	2326	72
MMO	190	10	52	298	14
ELECTRICAL	120	4	33	284	9
TRANSPORT	130	2	15	285	4
C & S	90	2	22	152	3
CRANES	71	2	28	642	11
TOTAL	1986	142	71	4921	232

This estimation is done on the basis of the prevalence found out from the examined group. And as the examination was done at random, it is presumed that this examined population would represent the whole working population in the various departments.