A Guide to Preventing Dermatitis While Working with Advanced Composite Materials

Safety & Health Assessment & Research for Prevention
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What are composite materials?

Composite materials consist of a binder or matrix material (often a resin) and a reinforcement, such as fibers or particles. There are three general types of composite materials: fiber-reinforced, particulate-reinforced, or laminar composites. There are many different types of fibers used in composite production, including glass, carbon, other organic fibers, Aramid (Kevlar), boron, continuous silicon carbide, and aluminum oxide. Of these, glass and carbon are the most widely used. Some components of composite materials are **sensitizers**, meaning that exposures to these materials can cause workers to become allergic to them. Advanced Composite Materials (ACM), are high performance materials such as prepregs, resin transfer molding compounds, and reinforced film adhesives. This document will focus on **prepreg** ACM use.

Why should I be concerned about composites?

People working in the production of composite materials or manufacturing of products using fiber-reinforced composites are at increased risk of developing **dermatitis**. Dermatitis is an inflammation of the skin, which may start with symptoms of redness, itching, swelling, and a burning or hot sensation. Without treatment, dermatitis can progress to broken or blistering skin, scaling, infection, **eczema**, or **psoriasis**. (Definitions of terms in bold typeface appear at the end of this fact sheet.)

Dermatitis is preventable!

Almost everyone working in facilities manufacturing composites or products made of composite materials has the potential for exposure to skin irritants, allergens, or sensitizers. Maintenance personnel, laboratory workers, technicians, shipping workers, and production workers can be exposed to prepregs, solvents, lubricants, resins, fibers, detergents, hardeners, strippers, and degreasers. The materials used in composite manufacturing can also cause other health effects, including occupational asthma and eye irritation.

- Employees working with composites may be particularly vulnerable to these skin problems because of continuous workplace exposure to fibers (which act as mechanical irritants), resin systems, solvents, and other chemicals.

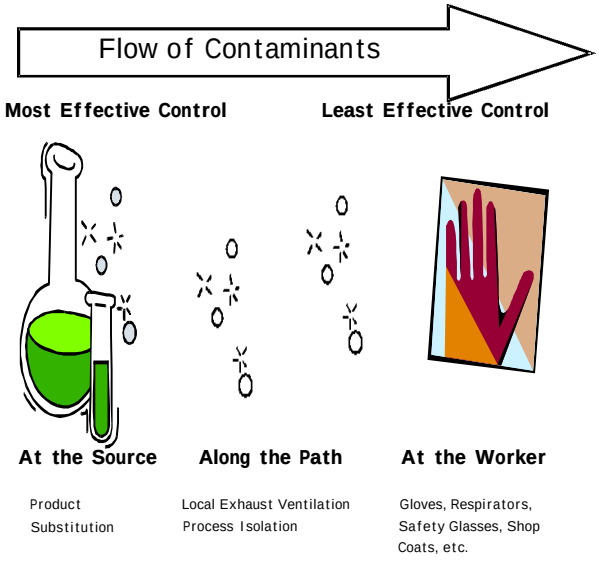
- A recent survey of occupational skin disorders in the State of Washington, conducted by SHARP, examined industry-specific workers' compensation claim rates. **Half of the industries with the highest rates use composite-fiber resin systems**, including sporting and athletic goods manufacturing; plastic products manufacturing; boat building and repairing; and aircraft parts and equipment.

- For the years 1993 through 1997 there were an average of approximately 61,000 reported cases per year of occupational skin disease in the United States. Skin disease accounts for about 13% of all occupational diseases over this time period.

- Prognosis can be poor, since many people who develop dermatitis will have long-term or chronic skin problems.
- Workers becoming sensitized to the material may have to move to another job or change occupations completely.

What can I do to prevent dermatitis while working with ACM?

Several steps can be taken to protect skin and prevent dermatitis from starting. When thinking about eliminating or reducing worker exposures it is important to rank exposure control methods in order of effectiveness.



The most effective exposure control is to eliminate the exposure, for example substituting a less hazardous substance for a more hazardous substance. This approach will not work in all situations. When elimination cannot be used, the hazard may be intercepted along its exposure pathway. Local exhaust ventilation is an example of a control for airborne exposures to dusts or chemical mists or vapors. In the case of dermal exposures in composite-using industries, sweeps and rollers can be used to prevent direct contact with these materials. Those controls implemented by the worker are the last level of exposure control. This level of control should be considered the "last resort" after other forms of exposure control have been considered technologically infeasible. It is appropriate to rely on personal protective equipment (PPE) while more effective forms of exposure control are being installed. Exposure controls implemented at the worker include PPE and administrative controls (work scheduling, worker training, and policies).

To effectively combat dermatitis, an exposure control plan should be developed. Typical exposure control plans will incorporate all three layers of controls to varying degrees. These concepts will be described by discussing the areas to consider when developing an exposure control plan.

- Industrial Process
- Education and Training
- General Work Environment
- Skin Care Program

"Zero Contact"

The best approach to prevent dermatitis while working with a composite material is not to have any direct skin contact with it.

This can be done many ways:

- Engineering Controls such as computer - driven pattern cutters (robotics) or local exhaust ventilation.
- Tools such as sweeps or rollers.
- Personal Protective Equipment, such as gloves and shop coats.

1. Industrial Process

Controlling Exposures at the Source

Reduce or eliminate the opportunity for skin contact with fibers or chemicals by automation or enclosure of processes. Substitute process chemicals with less irritating types, where

possible. This is the most effective level of exposure control.

Controlling Along the Exposure Path

Supply tools such as sweeps or rollers for use while laying up composite materials. Invest in dust control systems for those processes generating dusts (sanding, cutting, and grinding cured composite materials).

Controlling Exposures at the Worker

Controlling exposures at the worker using PPE may seem like a practical and cost effective way to protect workers. This may not be true in many situations. For PPE to be effective, it must be part of a larger exposure control program. Workers must understand the nature of the exposures, the limitations of PPE, and accept and use the PPE. Managers must ensure that PPE is correctly selected and worn. In other words for PPE to be effective, managers must plan on spending time training workers, monitoring PPE use, correcting inappropriate uses of PPE, and ensuring that replacement PPE is readily available.

Although product substitution and process controls are the best exposure control/worker protection strategies, some jobs involve direct contact with prepreg ACM materials. The nature of manufacturing items from prepreg ACM requires extensive handling of the prepreg material. Until the lay-up process can be automated and or modified to use less toxic or irritating materials, workers will be at risk of dermal contact with these materials. Currently, the use of tools (sweeps and rollers) and the vigilant use of PPE (gloves, disposable sleeves, aprons and other protective clothing) are the only practical means to protect workers form direct skin contact during the hand lay-up process.

Glove selection should consider the specific compounds used in the process and the length of time workers are exposed to these compounds. Table 1 provides a brief summary of some common glove types and the chemical or physical hazards they protect against. This is not a complete list; the degree of protection provided depends on glove thickness and duration of exposure.

Table 1. Glove Types and Contaminant Protection

Glove Type	Protects Against
Cotton	Abrasions
Disposable Plastic (Latex)	Microorganisms, mild irritant, fibers
Natural Rubber (Latex)	Acetone (<1hr), epoxies, MEK
Leather	Abrasions, punctures, and fibers
Neoprene	Acetone (>1hr), epoxies, N-methyl pyrrolidone (NMP)
Nitrile	Epoxies, isocyantes
Polyvinyl alcohol	Methylene chloride, toluene, MIBK, styrene, THF
Polyvinyl chloride	DMSO, isopropyl alcohol, epoxies
Rubber, butyl	Dimethylformamide (DMF)
Viton	Methylene chloride, 1,1,1-trichloroethane, toluene

Excerpted from "Save Your Skin! A Guide to the Prevention of Dermatitis" Suppliers of Advanced Composite Materials Association, Arlington, VA 1990.

It is important to have Material Safety Data Sheets (MSDS) available for all substances to help in determining the proper glove type. Employers are responsible for providing the appropriate PPE.

Every time gloves are put on, they should be checked for leaks, tears, or other damage. Several effective glove types should be available, because workers may have adverse

reactions to latex or other glove materials and variety helps to ensure acceptance (some workers may prefer one type of glove to another).

Gloves are effective only if workers wear them consistently.

One of the main difficulties with relying on PPE to provide worker protection is that it requires constant monitoring by both workers and management. Workers must **select** and **use** the proper PPE based on the nature and duration of the exposure.

Many workers resist wearing gloves because they claim the gloves interfere with their ability to "feel" the work. Ill-fitting gloves can interfere with dexterity and sensitivity. However, well fitting gloves, selected for the specific exposure hazard, and worn consistently and correctly can be an effective component of an overall exposure control program.

Dermatitis can occur in other parts of the body besides the hands, including the arms, face, trunk and legs. Protective clothing such as lab coats, arm protectors, goggles, hats, and aprons can reduce body exposure. Loose, long-sleeved shirts and pants are recommended to prevent fibers that do get caught in clothing from rubbing directly on the skin.

Barrier skin creams might be used to *supplement* but not replace PPE. Their effectiveness in protecting against exposures should be evaluated before they are used. However, these creams may contaminate work processes. All barrier creams will wear off during the day, so it is important to be cautious in the use of barrier creams.

2. Education and Training

It is important that information about dermatitis and its prevention is given to workers who are exposed to dermatologically active materials. This information should be part of the workplace safety and health training portion of the company's overall Accident Prevention Program. Training should include the following:

- general dermatitis information
- recognition of skin disease symptoms
- how and where to report cases of skin disease
- engineering controls used and how to ensure that they are operating properly
- use of appropriate PPE
- proper glove choice and use
- what to do if exposed to a toxic chemical
- housekeeping standards

3. General Work Environment

General workplace conditions can affect the development of dermatitis. Air temperature should fall within the range of 63^{o}F to 72^{o}F, with humidity at approximately 50%. Housekeeping is also vital to promoting healthy skin. Maintaining a clean workplace by cleaning up spills immediately, vacuuming, etc. can help prevent dermatitis by removing irritants from areas where workers are likely to contact them.

4. Skin Care Program

When dealing with work-related diseases like dermatitis, preventing the problem before it starts is crucial. Educating workers regarding hand-washing routines, proper use of household cleansers at home, and general hygiene precautions are essential elements of a skin care program. Workers should be instructed to wash their hands **before** eating, smoking, using the lavatory, and at the end of their shift, before leaving work. Providing gentle cleansers, and moisturizing creams in addition to PPE may be beneficial. Instituting a comprehensive skin care program for workers can enhance these prevention tactics. It is important that both new and current workers understand the dermatologic hazards they face and how best to protect themselves from those hazards. Training at the time of hire, as well as annual refresher courses would be a reasonable starting point.

An effective skin care program would include information on the following components:

A. Skin: The physiology of skin and skin care (use of soaps and emollients)
B. Dermatitis: Types of rashes (allergic, irritant, atopic dermatitis exacerbation, contact urticaria, and sensitization versus irritation)
C. Causes of dermatitis: Industry and company specific (Tailored to compounds used in the composite industry, include information on sensitizers.)
D. Prevention of dermatitis: ("Zero Contact" principle, describe engineering controls, tools available, personal protective equipment including glove selection and use.)

The program should alert workers to early signs of skin problems, so that they can be addressed before serious problems develop. Rules for reporting these injuries/conditions should be discussed so that medical treatment is immediately sought.

Some employers may hesitate to institute a comprehensive skin care program because they do not want to needlessly frighten their workers. However, if workers have enough information they can be a valuable resource. They can recognize and help institute practical solutions to workplace health and safety problems.

Exposure response: What to do if exposed to a compound that may cause dermatitis

- If exposed to chemicals or fibers, **respond immediately,** do not to wait until later or until it is "convenient".

- Before using chemicals or other substances, ensure that you understand the hazards associated with the compounds you will be working with, and be aware of any special emergency exposure procedures or clean-up methods.

- If skin is exposed to **fibers**, do **not** rub or scratch the skin. Remove any visible fibers by using sticky tape. Wash skin with cold water and soap. Moisturize skin after cleansing.
- If the skin contacts a dermatologically active chemical, rinse the area with lots of water then use soap if there is no skin damage. **Do not use solvents!** You may be tempted to use solvents to remove sticky resins or other chemicals from your skin. It is important to recognize that this is a dangerous practice and could lead to further skin damage or other adverse health effects.

By incorporating symptoms of dermatitis into health and safety training, workers and managers will be better able to recognize potential skin problems. It is also beneficial to ensure that the attending physician or occupational health specialist is aware of the types of exposures specific to the composite industry and the potential for dermatitis. If you notice any signs of dermatitis, medical treatment should be sought immediately. It is important to treat it medically as soon as possible to prevent progression to a more serious condition. It may be helpful to the physician to have a prepared list of specific materials handled by the affected worker.

Recommended Medical Professionals

Workers with dermatoses should be referred to a qualified occupational dermatologist for evaluation and management. Another option is to send workers to occupational health practitioners.

Remember: Dermatitis is a preventable condition. Work together to ensure a safe and healthy workplace.

Definitions

Composite- material composed of binder/matrix material and reinforcing fibers or particulates

Dermatitis- inflammation, redness, itchiness and/or skin irritation
Eczema- inflammation of the skin characterized by redness, itching, and small bumps, which may weep or ooze
MSDS- Material Safety Data Sheet. Description of the physical/chemical properties, toxicology, and proper handling of specific material, chemical or substance.
Prepreg – An advanced composite material which is pre-impregnated with the resin mixture. It may use a number of fibers for reinforcement (carbon, aramid, glass, kevlar, etc.).
Psoriasis- recurrent, long-term skin disorder characterized by red patches or bumps, and/or white scaly patches
Sensitizer- A substance causing the development of an allergic response.

Acknowledgments

Much of the information provided in this datasheet was derived from the Suppliers of Advanced Composite Materials Association (SACMA) booklet "Save Your Skin! A Guide to the Prevention of Dermatitis", published by SACMA in 1990. For further information about SACMA publications regarding composite materials, call (703) 841-1556.

Other references that were used for this document include:

- *Engineered Materials Handbook, Volume 1: Composites*. ASM International. Metals Park, Ohio. 1987
- *Fiber-Reinforced Composites – Materials, Manufacturing, and Design.* Marcel Dekker, Inc. New York. 1988.
- *Textbook of Clinical Occupational and Environmental Medicine*. Chapter 20 – Prevention of Contact Dermatitis. Table 9. Linda Rosenstock and Mark R. Cullen, eds. W.B. Saunders Company. Philadelphia, PA. 1994.
- *Safe Handling of Advance Composite Materials*. SACMA. July 1991. Arlington, VA.

Dermatitis related World Wide Web Sites

http://www.mc.vanderbilt.edu/vumcdept/derm/contact

http://telemedicine.org/contact.htm

http://www.mjc.org/msuhtml/msu_contact_derm.html

http://tray.dermatology.uiowa.edu/pips/pip-index.htm

http://www.wt.com.au/~dohswa/d_pubs/contderm.htm

http://www.npa.co.uk/publicdo/dermatit.html

http://www.derma.med.uni-erlangen.de/index_e.htm

What is SHARP?

SHARP stands for Safety & Health Assessment & Research for Prevention. SHARP is a multidisciplinary research program within the Washington State Department of Labor and Industries. SHARP's mission is to conduct research, monitoring, and demonstration projects that promote healthy work environments and the prevention of workplace injuries and illnesses. SHARP was created by the Washington State Legislature in 1990.

Since 1990, SHARP has addressed a diverse range of occupational health concerns in response to requests from employers, labor, health care professionals, and agency staff. SHARP's research specialists offer expertise in computer systems, economics, epidemiology, ergonomics, industrial hygiene, occupational medicine, occupational safety, and toxicology.

To obtain additional information about the program, please contact us at:

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