DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

CDC--MOUNT ST. HELENS VOLCANO HEALTH REPORT #20 August 29, 1980

Information on the Use of Air-Handling Systems in Areas with Volcanic Ashfall.

After the eruption of Mount St. Helens on May 18, CDC received numerous inquiries about the appropriate use of heating, ventilating, and air-conditioning (HVAC) systems in houses, hospitals, and other buildings. Dr. Wallace W. Rhodes, Jr., Ph.D., P.E., Consulting Engineer, has been working with CDC on various indoor air pollution problems, so we asked him to contribute an article for this report. (The condensed version below was taken from his article entitled "Air Filtration Study and Recommendations for Various Types of Buildings for Primary Removal of Ash and Particulates." Copies of the entire report can be obtained by writing the Center for Disease Control, Attn: Ms. Carolyn Forrester, Chronic Diseases Division, Bureau of Epidemiology, Atlanta, GA 30333.) He discusses such modifications of air-handling systems as the installation of electrostatic precipitators. It is important to stress that until further studies have been made, we have no evidence to indicate that indoor air levels of volcanic dust, even in the worst-affected areas, are a health hazard. Thus it is doubtful whether there is yet a need to modify standard air-handling systems. Nevertheless, health officials and others may feel the need to have further information on the engineering aspects, especially with the likelihood of further eruptions of Mount St. Helens, for some time to come.

The condensed report follows.

In general, the action to be taken during an ashfall or during periods when dust levels in the outside air are high is to shut off the external air intakes and exhausts and, if cooling is required, to operate on the internal circulation cycle only. Standard filters will remove large particles, including some as small as 5-10 microns in diameter, but not usually those in the respirable range (below 5 microns). This applies to homes and other buildings except hospitals, since the latter do not permit the recirculation of air in certain critical areas. The types of heating or cooling and the various sub-types of air handlers are immaterial because filtration systems can be used with any type. However, one cannot assume that with any given air-handling system replacing an existing filter with a more efficient one is satisfactory, because the system may not be able to cope with the increase in air resistance.

More specific information on 6 main types of buildings is given in the following sections.

I. Residences

Of all types of occupied structures, residences are perhaps the most prone to have their shells penetrated by airborne particulates. In addition, the heating system (and air-conditioning system, if it exists) is at best of a very nominal type and uses components that are completely inflexible. Possible actions for residences are as follows:

A. All cracks and crevices where particulates might enter should be completely weather stripped and caulked.

B. The heating system, if central furnace type with supply and return duct systems, will have only a very low-efficiency (10%-30%) filtering system. Also in furnaces in residences, the fan systems are very limited in their ability to provide proper air quantities if the filtering system offers too much filter static pressure. It is therefore necessary to improve the capability of the filtering system so that any airborne particles will be removed by recirculating the air in the occupied spaces. Thus the filtering system that would be most applicable, but not necessarily the least expensive, is the electrostatic precipitator (EP). An EP for a residence is a very small, compact filtering device that works on the principle of using a high-voltage field in which suspended particles become charged and are then deposited on electrodes of the opposite charge. In shape, the device resembles a picture frame and can be inserted in the return-air-duct system in a location conducive to proper maintenance. The main advantages of the EP is that it offers virtually no added resistance to the air stream and can remove all particulate matter in a moderately high efficiency range of 85%+. If an EP can be used, it has the advantage of not requiring filter replacement as the filter becomes "dirty"; it can merely be cleaned and wiped. The normal roughing filters downstream from the EP will catch any agglomerated blow-off. Many residences have no central heating system as described above, so an electrostatic precipitator installation could not be used in them.

An alternative would be placing 1 or more portable, ultra-high-efficiency filter fan units in the space to circulate the air and remove the particulate matter. These units are very effective and efficient, with a filtration efficiency in the 99.9% DOP range.

II. Motels

Most modern motels use under-the-window heating-cooling units that contain very low-efficiency filters in the range of 10%-30%. Also, because the fan systems for these units are very nominal, as is true in residential furnaces, it is virtually impossible to increase filter efficiency without reducing air quantities to unacceptable levels. Therefore, in general, the best approach for these systems is to try to increase the filter efficiency slightly by using a somewhat higher efficiency roughing filter with a viscous coating on the fibers. This will perhaps raise, with a proper filter selection, the filter efficiency to the 20%-70% range. The motel owner has the option of providing small individual fan filter room circulators as mentioned for residences (I). Some motels use fan coil units above suspended ceilings. These units also cannot overcome any great

amount of filter resistance and must be treated in the same manner as suggested for under-the-window units. Again, all occupied rooms and areas should be properly weather stripped and sealed to prevent the entry of airborne particulates.

III. Schools

These buildings can be provided with various types of HVAC systems, each one requiring a different approach to proper filtration methods. If the HVAC system consists of under-the-window units as described under Motels (II), the same methods should be used to increase efficiency in removing airborne particulates. If the HVAC system is a central air-handling system, an analysis must be done to determine how capable the system is of providing proper air quantities if higher-efficiency/higher-resistance filters are installed.

IV. Office Buildings

These buildings differ from very small buildings, which may use systems ranging from central, self-contained, packaged-type HVAC units to large, built-up HVAC components in very large multi-storied, totally enclosed buildings. The small systems, i.e., packaged and roof-top units, are low-efficiency air-handling units that can be fitted with electrostatic precipitator devices and down-stream, "catch-all" filters. This type of filter offers very little resistance to air flow but will remove a very large percentage of unwanted particulates, both from the return air system and any outside air that may be introduced. The very large built-up systems can also use the same EP method, but due to cost it may be more prudent to install high-efficiency filters that operate in a range up to approximately 95%. These filters offer more resistance to air flow, but due to the size and flexibility of large air-handling units, the fan speed can be usually be increased to provide the same air quantities and overcome the added resistance. This is not true in all instances, so the fan-blade angles and fan-motor horsepower limitations must be considered. An alternative if the motor horsepower is too small is to replace the motor and its components with a larger one or to use an EP as described above. Each individual case should be analyzed by a qualified HVAC engineer to determine the most prudent filtering method.

V. Industrial Buildings

Industrial buildings are so varied and complex that the HVAC components can range from very small window units all the way up to huge built-up fan systems that carry enormous quantities of air to occupied spaces. The same filtering techniques as described above under other types of buildings can be used, but it is essential that a qualified professional HVAC engineer properly evaluate the requirements for filtering particulates through the HVAC system and for preventing these particles from entering the building through numerous other openings. Filtration can be enormously expensive for such buildings.

VI. Hospitals

Because their structures vary greatly, hospitals have a wide assortment of HVAC systems. In patient-care areas, if particulates enter through the HVAC equipment or through windows and doors,

supplemental room filtration fan devices should be considered when levels of outdoor particulates are high. As far as unwanted airborne particulate matter is concerned, all areas in the hospital should be considered "critical," but most especially the operating room suite, intensive care units, cardiac care units, recovery areas, nursery areas, and isolation wards. Again, various systems can be used to furnish air to these critical areas, but generally all such units can and do furnish 100% outside air, without any air from the space being allowed to recirculate. In such a situation, it is necessary to have adequate, high-efficiency to ultra-high-efficiency filters (95%-99.97%+) in all such systems. Operating room suites usually have very effective filtering systems. It may be necessary, however, for an analysis of every HVAC system in the hospital to be done by a qualified HVAC engineer. The type of filtering system that generally is acceptable and does not require increases in fan sizes and motor horsepower is the EP and a down-stream filter. The EP causes the very small to larger particulates to agglomerate, and they are then blown off and trapped in the down-stream filter. The EP does require regular maintenance in the form of cleaning, but does not require replacement, as do the shorter-term disposable filte

CDC--Mount St. Helens Volcano Health Reports will be published once a week until further notice. Information in these reports represents the latest data reported to CDC; much of the information is preliminary in nature and subject to confirmation and change. It is distributed for the purpose of providing up-to-date health data from CDC and the many other groups involved in public health assessment. We hope to continue to receive relevant reports and data from others working on this problem.

Henry Falk, M.D., Peter J. Baxter, M.D., Roy Ing, M.D., Jean French, Ph.D., Clark W. Heath, Jr., M.D., Director, Chronic Diseases Division, Bureau of Epidemiology, CDC, Atlanta, Georgia. Robert Bernstein, M.D., and James A. Merchant, M.D., Director, Division of Respiratory Disease Studies, NIOSH, CDC, Morgantown, West Virginia.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396