Carbon filters protect greenhouse plants from air pollution damage

AIR POLLUTION FILTERS FOR GREENHOUSES

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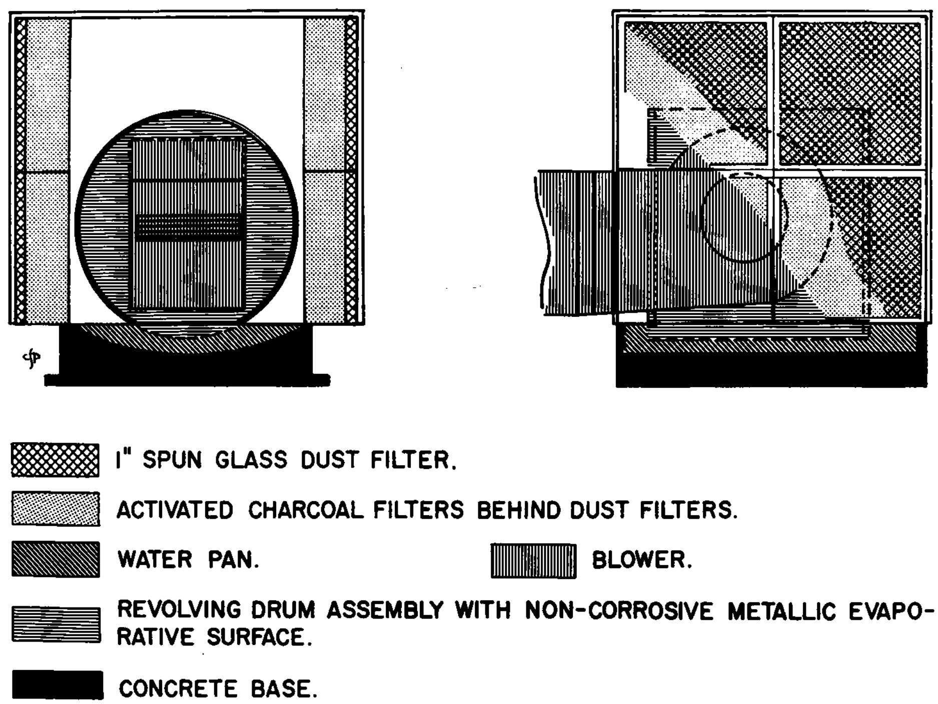
Air pollution in the Los Angeles and San Francisco Bay areas of California causes damage to the foliage of many plants and reduces the growth of a variety of glasshouse-grown crops.

Air pollution also hampers a wide variety of critically controlled plant experiments conducted by several research institutions. Moderate to severe plant damage has been recorded during the past several years, for all but a few weeks in the winter months, in standard glasshouses at Riverside.

Plants in glasshouses can be protected from photochemical air pollution by passing all of the air entering the house through activated carbon filters. The phytotoxic products of the photochemical reactions are ozone, peroxyacetyl nitrate—PAN—and the oxidants, as yet unidentified, produced by ozone-olefin reactions. Although ethylene occurs in the photochemical air pollution complex and is damaging to a variety of plants, it is not removed by activated carbon. Bromination of the carbon effects the removal of ethylene, and work is under way to adapt this principle to glasshouse filtration.

The eye irritants—PAN, acrolein, and formaldehyde—as well as the odors associated with the photochemical reactions also are removed by activated carbon.

Previous studies on photochemical plant damage, conducted at Pasadena, demonstrated that activated carbon would remove those phytotoxicants which were the cause of oxidant plant injury, whereas electrostatic precipitators and water scrubbers would not. At Riverside, in addition to air filtration, adequate cooling is required during the summer months. Consequently, a combination filter-cooler unit was developed for use in glasshouses in the air pollution research program at Riverside.



Schematic drawing of side and front elevations of filter-cooler unit showing relationship of filters, revolving drum, blower and water basin.

Filter-cooler unit

The filter-cooler unit consists of a rotary drum type evaporative cooler with squirrel-cage blower enclosed in a galvanized metal box. Two sides of the box are fitted with commercial, folded type, activated carbon panels and suitable oil-treated glass fiber dust filters. The unit is constructed so both carbon and dust filters can be easily and properly sealed in place without requiring the individual bolting frames usually supplied with the filters. Eliminating the frames results in a lower initial cost and provides for easier inspection and replacement.

When the unit is in operation, the air flows consecutively through the dust filters, carbon filters, bronze-wool wall of the evaporative drum and the squirrel-cage blower, and into the glasshouse. Thus the moisture-laden cool air does not contact the carbon.

Coal carbon is used in the filters of the unit. Shell carbon is reportedly a better grade than coal carbon, but there is no evidence that shell carbon is any more efficient than coal carbon in removing the phytotoxicants. Under Riverside conditions the carbon has required changing or reactivation every 14 to 20 months.

The cost of reactivation is about one fifth of the original price of the panel.

Carbon is changed when it is reduced to 10- to 12-minute activity. As yet, the phytotoxicants have not passed through carbon of this activity. Tests are now under way to determine how much greater loss of activity may be tolerated before plants within the house are injured.

Size varies

The size of the filter-cooler unit varies with the size of the glasshouse, or section of a house, to be filtered. The requirement at Riverside is to provide 1,000 cfm (cubic feet per minute) at maximum air flow for each 1,000 cubic feet of space. The better carbon panels available have a rated capacity of 1,000 cfm; thus, the unit should be of a size to provide one 2 x 2 foot filter panel for each 1,000 cubic feet volume in the house. The blower also has to be of corresponding size.

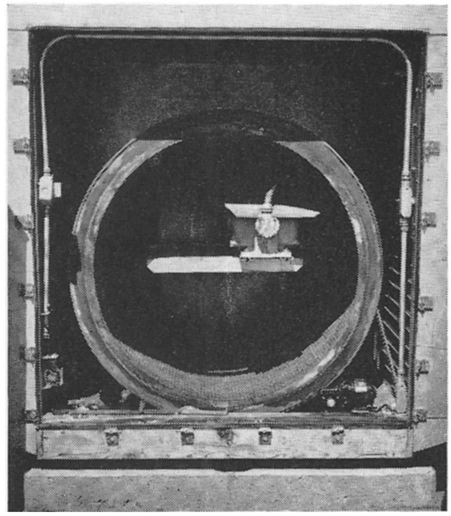
Most of the units at Riverside are cubes, 4 feet on a side, which provide a maximum of 8,000 cfm by placing four carbon panels on each of the two sides. If fewer cfm are required, fewer panels are positioned and the unused panel space is replaced with a solid sheet of metal. Air flow rate is reduced by changing either the speed or the size of the blower. Conversely, if more cfm are required, a second complete unit is added, one unit being used for each 6,000 to 8,000 cfm.

A double-louvered register is usually installed at the distal end of the transition inlet in the wall of the glasshouse, to distribute the air as evenly as possible.

Positive pressure

The basic principle involved in filtering is to keep the interior of the glasshouse under positive air pressure at all times with as low a flow as possible and to supply more cfm only as cooling is required. Air flow through leaks in the house or through opened doors is always from inside to outside, and air-borne oxidants cannot enter the house without first passing through the filter.

At least one of the filter-cooler units on a house, or section thereof, is provided with a two-speed blower motor. The low speed is on continuously and delivers enough cfm to keep the house under positive pressure. As requirements for cooling increase, water flows into the reservoir, a small motor driving the cooling drum is switched on automatically, and the surface of the rotating drum becomes wet; the two-speed blower motor shifts to high



Filter cooler with back plates of cooler and drum removed to show blower inside of drum. Drum rests on two rollers and is rotated by action of small motor at lower right.

speed, and a second filter-cooler unit—if the house is of such a size as to require more than one unit—with a high-powered, one-speed blower is switched on.

When the house is receiving the maximum air flow required to maintain desired temperature and as cooling is satisfied, the units go off in the reverse order. While the drum is rotating, the water level in the basin is maintained with a float and valve. When the drum stops, a solenoid-actuated lever opens a drain to empty the basin. Thus each time the drum operates, a fresh supply of clean water flows into the basin.

Air escape

As the cfm increase during cooling, provision should be made for escape of the additional volume of air over and above that needed to keep the house under positive pressure. Two systems have been tried at Riverside: *1,* opening and closing of the ridge vents, with motors actuated either by a pressure valve or by a switch connected to the high speed of the blower; and *2,* weighted pressure louvers installed at various places in the glass wall of the house. The area of the louvered vents is in the ratio of one square foot to 1,000 cfm air flow. The second method is entirely adequate, is less costly to install, and requires little or no maintenance.

Another feature incorporated into the filter-cooler units is that of placing a steam-heat coil in the transition duct of the one unit which runs constantly. By having this coil thermostated at a temperature a little below that of the house, air is preheated during cold weather when the unit is running at low speed, thereby minimizing uneven temperatures in the house and preventing cold injury to plants situated near the intake duct.

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CHICKEN DISEASE DIAGNOSIS

In 1957, southern California poultrymen reported a mysterious inflammation of the eyelids affecting birds of different ages. Both broilers and laying flocks suffered losses that in a few cases exceeded 50 per cent of the affected birds. Occasionally the disease was observed in flocks recently vaccinated against infectious laryngotracheitis.

In the acute and the recovery stages, the eyes assumed a slanted appearance generally referred to as almond-shaped eyes. Watering of the eyes was common. Complications with bacteria often resulted in the shutting of the eyelids.

A representative sample from an affected flock of two-month-old White Leghorns was obtained for study. Laboratory examinations proved that the condition was caused neither by Newcastle disease nor fowl pox. The fluid from the eyes was examined and a virus—isolated in chicken embryonating eggs—was discovered to be the virus of laryngotracheitis as it is commonly found in the field.

Later cases reported to the laboratory for examination confirmed that the inflammation of the eyelids was caused by this virus. A simple method was devised to diagnose the disease, consisting of sectioning the eyelids and looking for inclusion bodies which represent a typical indication of the presence of the virus.

It was therefore demonstrated that this apparently mysterious hemorrhagic conjunctivitis present in the field is nothing but a form of laryngotracheitis. If hemorrhagic conjunctivitis should appear in a flock of hens, it is advisable to take a representative sample of chickens to the nearest diagnostic laboratory or to the University of California for identification of the condition.—*L. G. Raggi, Dept. of Avian Medicine, Davis.*