CHAPTER 9

CARTRIDGE AND DIATOMACEOUS EARTH (D.E.) FILTERS

LEARNING OBJECTIVES

After completely studying this chapter, you should be able to:

- List the advantages of cartridge filters compared to sand or D.E. filter systems.
- Understand and list the cleaning methods of cartridge elements.
- Explain the effect of hot tub water temperatures, the release of body oils and the implications for cleaning the pools' filters.
- Calculate the amount of D.E. powder necessary for precoating a filter.
- Understand how diatomaceous earth filters trap dirt and debris.
- List conditions or problems that shorten the filter cycle of operation.
- Explain how to correct filtering problems that interfere with proper operation.
- Understand why it is necessary to stop the pump when changing valves or settings on a D.E. filter system.

Cartridge Filters

Cartridge filters for pools are relatively new in the marketplace. They are usually installed on smaller, spa/hot tub installations but can be used for swimming pools. Cartridge filters are constructed of a fiber material, which is very effective in removing dirt and suspended matter when water passes through it.

A few standard sizes and shapes of swimming pool cartridge filters.

The single-element cartridge filter adds an entirely new dimension to swimming pool filtration and offers some unique features that are not available in either high-rate sand or DE filters. Some of these features are as follows:

1. Compact, lightweight, easy to install, and no backwashing required.
2. More effective filtration area in a very compact system.
3. Less maintenance and longer filter runs between cleaning.

Sizing Cartridge Filters

The only definite size standard that has been set pertaining to the use of cartridge filters on commercial pools is that of the National Sanitation Foundation (NSF).

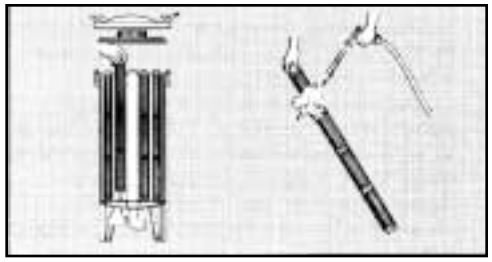
The NSF Standard for commercial pools specifies a flow rate of 0.375 gallons per minute for all cartridge filter types. Flow rates greater than 0.375 gpm through a cartridge filter reduces the filter cycle and therefore reduces filtration effectiveness.

Cleaning Cartridge Filter Elements

Normally, the fiber elements of cartridge filters can be cleaned by simply applying water to the element from a hose and nozzle. However, improper pool water chemistry can produce problem conditions. Visually inspect filter cartridges and check for build-up of contaminants by feeling the surfaces on a regular basis. When a filter element becomes contaminated with algae, calcium carbonate, iron or binders used in chlorine tablets, special cleaning procedures must be performed. When problems of this nature occur, the following steps are recommended:

1. Remove accumulated dirt by washing the element using a hose and nozzle.
2. Remove oils and other debris by soaking the element for one hour in a solution comprised of one cup of automatic dishwasher detergent mixed with five gallons of water.
3. While wearing personal protective equipment, mix a solution of four cups of muriatic acid with five gallons of water in a plastic container. Allow the filter element to soak for approximately four hours. Thoroughly rinse the element in a solution composed of 0.1 pound of soda ash per one gallon of water. This neutralizes the acid residual remaining on the element.
4. Keep a complete set of spare clean filter elements available at all times. This will ensure that filtration will not be interrupted between cleaning processes.

NOTE: Never use a brush to scrub the surface of the element.



Many pool operators keep two complete sets of cartirdge filters on hand. When one set gets dirty, put the second set into the filter and clean the dirty set when time is available. This eliminates filter down-time.

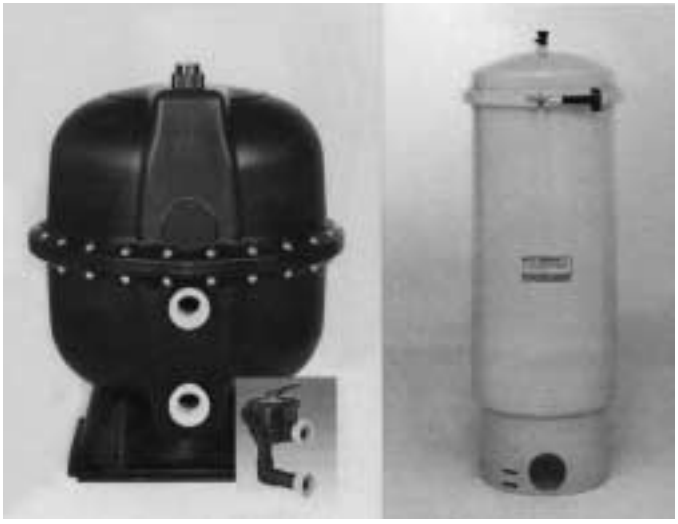
Cartridge Filters Used for Spas and Hot Tubs

Cartridge filters used in spas and hot tub installations are subjected to a higher concentration of body oils than those used in swimming pools. Spas and hot tubs operate at temperatures that are approximately 25 degrees Fahrenheit higher than that of swimming pools. This elevated temperature causes a greater amount of body oil to be released and into the water. As a result, cartridge filters used on spas and hot tubs will require more frequent cleaning than those used on a swimming pool. Failure to provide more frequent cleaning will result in severe clogging of the element.

Diatomaceous Earth (D.E.) Filters

Diatomaceous earth (D.E.), also called "diatomite", is a white, odorless silica powder originating from skeletons of microscopic single-cell plants. These single-celled plants—diatoms—flourished about 15 million years ago in certain bodies of water. Properly applied to the pressure side of filter elements, it forms a porous, relatively non-compressible coating through which water readily passes. Dirt particles, lint, hair, certain bacteria and protozoa, as well as other suspended impurities, do not pass.

To form this coating on the filter element, diatomite powder is added to the water flowing through the filter tank, where it is trapped on the screen (grids or elements) as a uniform "precoat" about 1/16- to 1/8-inch thick on every part of each filter element. This coating of "filter cake" is the filtering surface that entraps suspended particles, holding them until the filter is backwashed. After backwashing, the "filter cake" is then discarded and replaced with fresh diatomite. Remember that the principal purpose of filtration is the removal of suspended dirt. It is not a substitute for proper disinfection and chemical treatment of the pool water.



D.E. filters are special tanks containing a series of covered filter grids. Diatomaceous earth is introduced into the filter by the pump and covers the filter elements. The D.E. allows water to pass through but collects the smallest of suspended dirt particles. When cleaning is needed, the water flow is reversed (backwashing) and the dirt and D.E. are sent to a waste line.

Whether the D.E. filter system is of the pressure or vacuum type, the water flow is first through the filter cake, then through the filter elements, finally to the clean-water effluent piping. Because many models and types of filters are marketed and approved for use, check

the manufacturer's instruction list and data plate on the tank for the information needed to follow these basic procedures:

- Prime the pump before starting the filter. Run the pump to fill the filter tanks with water, and then open the air vent (if provided) or otherwise bleed all air from the top of the tank.
- Follow the instructions for precoating using 0.125 pounds (or 2 oz.) of diatomite per square foot of filter surface area. For example, a 50 sq.ft. filter would need 50 sq.ft. x 0.125 lbs. = 6.25 pounds. Measure the diatomite using a container such as an empty one-pound coffee can (this holds about 7 or 8 ounces of diatomite).
- Make a slurry by premixing the required amount in a bucket and stirring the powder into a convenient quantity of water.
- Set the filter control valve or effluent valve to "recirculate," or, if not provided, set to "filter to waste" or "rinse." Be sure to stop (turn off) the pump when changing valves. Never close all valves at the same time because it could damage the pump or filter.
- Do not allow the filtered water to return to the pool until it runs clear: the flow of filtered water for the first 15 to 30 minutes after precoating may contain enough fine particles of diatomite to cause cloudiness in the pool.Unless it is time to backwash the filter, never stop the pump for any reason. Any interruption of water flow will allow part or all of the diatomite coating to drop off the filter elements. If this happens, filtration stops and the effluent is just as dirty as the unfiltered water because all or most of the water passes through the uncoated areas of the filter.

Backwash pressure-type diatomite filters when the influent and effluent gauges show 10 to 20 psi pressure differential (vacuum filters, about 10 to 15 inches of mercury vacuum), depending on the original design. Several factors can shorten the filter cycle or length of time that the filter can be operated between backwashes, including:

1. A heavy dirt load in the pool, such as debris falling or being blown into the water, or an unusually large number of poorly showered bathers.
2. Wrong grade or quantity of diatomite filter-aid being used. Check the manufacturer's instructions. Never cut back on the recommended amounts; this will add to the cost of maintenance in the long run.
3. Clogged hair strainer or skimmer baskets.
4. Partial loss of coating on filter.
5. Accumulated grease, hair, oil, suntan lotion, algae cells, or any slime and dirt clogging the filter elements. Chemical cleaning with tri-sodium phosphate and or muriatic acid may be needed to remove them.
6. Inadequate backwashing, leaving part of the old filter-aid coating in place. In extreme cases, this may require disassembly of the filter to dislodge the accumulation of debris by using a strong water jet or gently removing it with a wooden stick.
7. Damaged gaskets, elements or other internal parts can permit filter-aid and dirt to pass through the filter grids causing cloudy water.
8. Compaction of filter-aid coating due to excessive flow rate. Watch the flow meter and pressure gauges and adjust valves, as necessary, to maintain the design flow rate. Compaction can be slowed by the continuous addition of filter-aid ("body feeding") at a slower rate, about one to five pounds of diatomite per 100,000 gallons of water through the filter. (A 36,000 gallon pool with a 6-hour turnover would then need about 1-5 ounces of powder per hour, depending on the dirt load in the water). This creates a clean, prime filtering surface preventing sliding and or a rapid increase in pressure differential.
9. Air-binding of the filter tank, preventing proper precoating of the entire surface of each filter element.
10. Calcium deposits on filter elements, reducing the available screen area. When the pH rises above 7.8, the dissolved calcium is likely to precipitate on the elements. This may necessitate disassembly of the filter and cleaning the elements. Check the manufacturer's recommendations before attempting this procedure.
11. Undissolved particles of calcium hypochlorite accumulating in a glaze over the surface of the filter-aid coating, cutting off the flow. All such compounds should be completely dissolved before being added to the pool to prevent any insoluble residue from entering the pool.
12. Improper chemicals being used, such a alum, which is a filter aid for sand filters but is NOT to be used in a diatomite filter.
13. Inadequate disinfectant (chlorine, etc.) being used, allowing bacterial or algae slime to interfere with proper precoating.

The need to correct each type of difficulty suggested above is usually self-evident. For further detailed information, consult the instructions furnished by the filter manufacturer.

CHAPTER 9

Review Questions

Cartridge and Diatomaceous Earth (D.E.) Filters

Write the answers to the following questions, then check your answers with those in the back of the manual.

1. Name three advantages that cartridge filters have over sand filter or D.E. systems.

2. What is specified filter flow rate for cartridge filters as established by National Sanitation Foundation (NSF)?
   a. 5 gallons / minute / square ft. of surface area
   b. 3 gallons / minute / square ft. of surface area
   c. 1 gallons / minute / square ft. of surface area
   d. 0.375 gallons / minute / square ft. of surface area.

3. List the four-step procedure for cleaning cartridge filter elements.

4. What effect does spa pool water have on cartridge elements?

5. Explain why D.E. powder stops more dirt and debris than a sand filter.

6. How much D.E. powder is needed for 75 sq. ft. of filter surface area?

7. What happens if filtered water has too much D.E. powder in it?
   a. It may encourage algae to grow.
   b. The pool could turn cloudy from the fine particles of diatoms.
   c. Swimmers skin and eyes will be irritated.
   d. The pH will fluctuate until the D.E. precipitates.

8. What could happen if the valves were not closed or the pump is not turned off when switching operation modes?

9. List seven problems or conditions that cause a shortened D.E. filter run.

10. From the above listing of problem conditions, choose four problems and explain how to correct the situation.