

Blue Earth Products®

# Packed Tower Cleaning Guidelines

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Essential instructions for the planning and implementation of packed tower cleanings



v.2

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**Note:**

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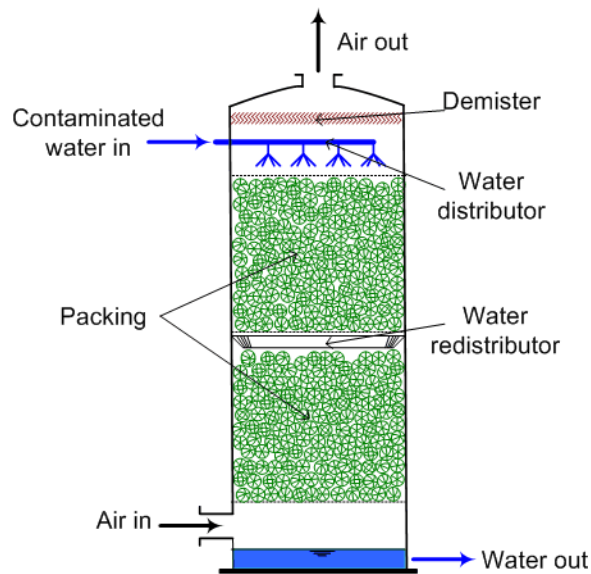
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## Background

### Packed Towers (Stripping Towers)

Vertical stripping towers are typically designed to remove volatile organic (VOC) or volatile inorganic compounds from the source water. In principle the VOCs are removed from the incoming water (influent) by providing a means to reduce the water droplet size and force the separation of the VOCs by blowing air up through the cascading water droplets, forcing the VOCs out the top of the tower.



**Figure 1** – Typical packed tower.

There are typically three basic sections to the tower. (1) The top section receives the influent water from the source, and the water is evenly distributed across the cross-section of the tower by the distribution tray, which is a metal plate having several holes for the water to pass through and several larger holes designed to allow the rising air to also escape. Above the distribution plate is typically a mesh, filter-like assembly called the *mist eliminator*, which captures water particles from the escaping air and channels them back into the tower.

(2) Below the distribution tray is the central section of the tower where the *plastic media* is located. These media are *multifaceted geometric shapes* that are designed to have hundreds of surfaces. These surfaces break the fall of the water coming from the

distribution tray, and also break up the cascading water streams into much smaller droplets so that the VOCs can be more easily separated from the water molecules.



**Figure 2** – Examples of packed tower media both clean and fouled.

Unfortunately the minerals and other naturally occurring elements in the source water also tend, over time, to cling to the surface of the plastic media. Eventually the faces of the media become enlarged until the effectiveness of the separation is reduced by the reduction in the number of media facets. When the buildup or accumulation becomes great enough, the media balls can become seemingly welded together, until the cascading water can short-circuit areas of the media column. It is even possible that, over time, the entire column of media can become almost entirely blocked. In such a case the media would have to be removed—possibly by jack-hammering—and replaced. The chemical cleaning process is a means to avert the replacement of the media, when employed on a regular basis.



**Figure 3** – Example of tower basin and blower.

(3) The third section of the tower, located at the bottom and below the media column, is the *basin* section where the cascading water accumulates and is discharged as the tower *effluent*. To the side of the basin is located the *air blower*, which provides the air to drive the VOCs from the packed tower.

(Note: In some packed towers the distribution tray is replaced by a *spray manifold*, which sprays the influent water over the surface of the media column. The manifold is provided with *nozzles* that are sized according to the various parameters of the tower. The spray manifold design seems to be more effective in providing a means to separate the VOCs from the water droplets. One drawback to this design is that the nozzles can eventually become clogged by the various contaminants in the influent water, such as iron.)

## Pre-Cleaning Preparation

### Preparation of the tower

- 1) Read the “Important Safety Notice” at the end of this manual
- 2) Take the tower offline.
  - a) Influent valve must be closed.
  - b) Effluent valve must be closed.
  - c) Main power switch must be “off” in the office.
  - d) Knife switch on the blower must be “off.”
  - e) All circuits on the outside control panel must be “off” or “manual.”
- 3) Apply lockout locks (one for each worker) to the main power switch (“c” above).



Figure 4 – Example of switch lockout

- 4) Check access/escape routes and verify that ladders and hatches are safe and secure

**NOTE: IT IS CRITICAL YOU ALWAYS COMPLY WITH OSHA CONFINED SPACE AND FALL PROTECTION PROCEDURES**

- 5) Verify that electrical power is available for running the compressor and ensuring proper lighting. Use Shock Buster connectors for electrical equipment
- 6) Install rinse water supply (fire hose)
- 7) Safety Assessment Form must be finalized and posted
- 8) Apply WD-40 to the hatch bolts.
- 9) Might need to use the electric impact wrench and impact socket.



**Figure 5** – Example of manway hatch cover.

- 10) Remove the lowest manway hatch cover. If the hatch cover cannot be pulled away, use a pry bar or screw driver to assist.
- 11) Set the hatch cover aside. NOTE: the gaskets will become damaged and must be removed from both hatch covers.
- 12) Place boot rinsing tray at entry and fill with 1:10 diluted Floran Catalyst<sup>®</sup> or 12% Bleach. Step into tray each time you enter the tower
- 13) At the top tower landing, remove the 2<sup>nd</sup> highest manway hatch cover, as before.
- 14) Use a 5-gallon bucket with bale and rope to hoist the tools, etc., to the landing.
- 15) Tie off the rope to the handrail for future use.
- 16) The media balls at the top of the media column may have become mounded, unevenly distributed. This should be corrected by using a long-handled leaf rake to pull the media balls to the center of the column.
- 17) Remove the plug/cap from the side drain on the of the tower, to drain the remaining water in the basin.
- 18) De-chlorinate water if needed, according to state and federal laws
- 19) Install an inflatable rubber plug in the effluent line if needed, to prevent any chemicals from entering the effluent line.
- 20) Use the air compressor or bicycle pump to inflate the plug to about 25 psig.
- 21) Tie off the plug using the attached rope lanyard.
- 22) Place the cut-off drum over the effluent line.
- 23) Apply a proper layer of thread tape and replace the side drain plug/cap. Tighten with the large adjustable wrench.

## Personal Protective Equipment

- Chemical coverall - wear legs and sleeves outside boots and gloves
- Rubber boots - no lace-ups
- Full-face respirator with combination organic vapor / acid gas cartridges with a minimum of a N95 pre-filter attached if entering or spraying inside tower.
- Rubber gloves
- Hard hat
- Harness
- Fall protection line grab and descent control device



## Tower Cleaning Procedure

### Tower Cleaning

- 1) See “Quality Control Measures” for some quality control suggestions.
- 2) Mix cleaning chemistry of choice [CSR Plus®, Top Ultra®, Floran® Biogrowth Remover, Floran® Biodegreaser] as directed by your Blue Earth Products representative, with Floran® Catalyst at a 10:1 ratio
  - Only mix one container at a time.
  - Use the entire mixed amount even if the tower looks clean. **[IMPORTANT: CLEANERS THAT HAVE BEEN MIXED WITH FLORAN CATALYST MUST NEVER BE RECLOSED]**
  - If Floran Biodegreaser® is used; it must be applied prior to application of acid based cleaner of choice.
- 3) Place a 55-gallon open-top drum near the tower and fill with fresh water, to be used for quick flushing, hand washing, and pump priming.
- 4) Pump the CSR Plus from the shipping container into the top of the tower through the open manway.
  - Use a slurry (“trash”) pump properly placed in a catch tray.
  - Be sure the pump is fueled.
  - Use only approximately 175 to 200 gallons of chemical per cycle.
  - Using a long pole as a “stiff arm” attached to the end of the pump’s discharge hose, distribute the chemical as evenly as possible over the top of the media column, preferably covering only a quadrant or portion of the media column.
  - When the appropriate amount of chemical has been pumped into the tower, stop the pump and move the suction line to the tower basin.
- 5) Circulate the chemical within the tower.
  - Use the water hose with spray nozzle to control the foam.
  - A quart of Foam Break may be added if needed to assist in reducing foam.
  - Continue to move the discharge hose thoroughly over the selected quadrant of the media column.
  - Use the two portions of the divided 5-gallon container to catch any liquid that drips from the manway opening.
- 6) Monitor the pH of the chemical. The pH will rise, both from the addition of water by controlling the foam, and from the action of the chemical on the iron and other contaminants on the media. Eventually the chemical’s pH will rise to between 3 and 4. It is at this stage that the chemical must be transferred from the basin and the tote to a backwash basin if available.

- Use the water hose to flush the chemical from the pump and hoses that send the chemical to the top of the tower.
  - Use the 2<sup>nd</sup> pump to discharge the spent chemical to the backwash basin.
  - Add one 50-pound bag of pHaze to the backwash basin or more to neutralize.
- 7) Repeat steps 2 through 8 to add fresh chemical to the tower media.
  - 8) It is advisable to use a smaller catch pan to keep the chemical from running out of the manway while the chemical is circulated in the front quadrant of the media column.
  - 9) Repeat step 9 as needed to use all the chemical for the tower.
  - 10) When the last of the chemical has been used and has been spent and discharged, the pumps and hoses and totes and drums must be thoroughly flushed with fresh water.
  - 11) Use the chemical spray system (small compressor, small air diaphragm pump, tubing, and spray wand) to apply fresh chemical to the underside of the media column. This will require about fifteen to twenty gallons of chemical, evenly divided for about three to four applications and rinsings.
  - 12) Pump out the chemical remaining in the basin.
  - 13) Use the shop vacuum to remove as much liquid from the basin as possible. Empty the shop vac into an open-top drum; pump out the drum as needed until the basin is clean and drained.
  - 14) Refer to the Runoff Treatment and Disposal Procedure in this manual for treatment of the runoff.
  - 15) The cleaning stage has been completed. The site must be straightened up, all equipment properly cleaned and stowed for the following day of rinsing.
    - Remove the slurry discharge hose from the upper manway of the tower.

## Rinsing Procedure (also Annual cleaning strategy – rinsing)

- 1) Disinfect and defoam the tower
  - a) Fill a tote with water, 1.5 gal of Foam Break, and sufficient bleach to disinfect the tower.
  - b) After draining the spent treatment chemistry from the tower, add the bleach solution to the top of the tower and recirculate for 30 min before discharging.
- 2) Perform a final rinse of the tower using either the system pumps (without the blower) or with water from a fire hose.
- 3) The following is the procedure for using a fire hose:
  - a) Connect about three sections of fire hose from the fire hydrant to the top of the tower, using the fire hydrant wrench and the spanner wrench to tighten the connections.
  - b) Be sure the spray nozzle on the fire hose is in the CLOSED position.
  - c) Properly tie off the fire hose to the hand rail using the available rope.
  - d) Be sure the fire hose spray nozzle is in the CLOSED position.
  - e) Open the fire hydrant using the fire hydrant wrench. Open slowly to prevent water hammer in the system.
  - f) Set up at least one slurry pump with 1" hoses to transfer the rinsate from the tower basin to the backwash basin. Two-inch hoses may be substituted.
  - g) Have the water hose with spray nozzle on hand at the bottom manway for foam management if needed.
  - h) Remove the effluent line covering drum from the basin.
  - i) With the nozzle placed well into the top of the tower, open the fire hose nozzle and begin applying the water stream throughout the top of the media column. It will require a substantial volume of water over several hours to adequately rinse the chemical from the media. *SAFETY NOTE: The 1-1/2" fire hose and nozzle can be difficult to control. It is of utmost importance that the hose be properly secured to the handrail during the cleaning process. It is possible for the worker to be thrown from the landing if the hose is not secure.*
  - j) Use the slurry pump(s) to keep the basin emptied of rinsate and foam.
  - k) The tower is considered adequately rinsed when the foam being generated is completely white, without discoloration, and the pH is the same as the water from the water hose.
  - l) When the rinsing is complete, the site can be returned to normal.
  - m) Close the fire hose nozzle.
  - n) Close the fire hydrant, using the fire hydrant wrench. Close SLOWLY to prevent water hammer.
  - o) Remove the fire hose from the tower and disassemble the fire hose stream.
  - p) Drain the water from the fire hoses and roll the hoses with the male threads at the center of the roll; stow the fire hoses, nozzle, and wrenches.
- 4) Drain all the rinsate water from the tower basin using the slurry pump and the shop vac.

- 5) There will be an accumulation of sludge in the tower basin that must be removed by entering the basin.
- 6) Vacuum away any liquids that have accumulated at the top of the effluent line.
- 7) Deflate and remove the effluent line plug.
- 8) Vacuum away any liquids that remain in the effluent line, to a depth of about 4 ft.
- 9) Contact operator that the tower is cleaned and ready for his inspection and for returning to service.
- 10) Refer to the Runoff Treatment and Disposal Procedure in this manual for treatment of the runoff.
- 11) Clean up all equipment and totes and other containers.
- 12) Properly stow all equipment and load for travel.
- 13) Upon approval, the hatches must be installed with new gaskets. Tighten the bolts appropriately. If new bolts, nuts, or washers are needed, obtain at a local hardware store.
- 14) When instructed, the system can be returned to service. Remove personal lockout locks.
- 15) Return the site keys to operator.
- 16) Depart site, "better than it was before arriving!"

## Runoff Treatment and Disposal Procedure

Tower cleaning treatments using Blue Earth Products chemical products produce runoffs that need to be discharged and disposed of in compliance with state, local, and federal safety and environmental requirements. It is very important to discuss the discharge procedures with the customer before scoping or pricing a job. Customers might have their own concerns in addition to regulatory issues, but in most cases operation personnel are helpful in determining the correct procedure.

Packed tower cleanings produce significantly lower volumes of runoff than filter media treatments. The runoff consists of the chemicals used, the rinse water and the dissolved and suspended solids that are dislodged from the walls, media, and present in residual sediment. In order to minimize the volume of runoff and thus make discharge easier, all heavy sediment should be flushed out of the tower before pumping the cleaning products. Final disinfection, if required, must be performed after all runoff is removed. No further flushing is done after disinfection.

Discharge of the runoff to the sewer or sludge lagoon is the preferred method of disposal. Some towers have drains to the sewer and runoff can be flushed out easily while others have sewer manholes close enough to allow for pumping the runoff as a disposal point. If no such option is available, a pump truck can be used to collect the runoff and deliver it to the sewer plant. For discharge to the sewer, the pH of the runoff usually has to be adjusted to 6-9. Blue Earth Products has three products that can be utilized to accomplish the neutralization process: pHinish-L<sup>®</sup>, pHinish-S<sup>®</sup> & pHaze<sup>®</sup>.

Discharge to a ground or storm drain is less desirable than discharge to the sewer or sludge lagoon and usually requires approval from the city who must have a National Pollutant Discharge Elimination System (NPDES) permit in accordance with the Clean Water Act. If the customer approves, the runoff has to be neutralized, de-chlorinated and sometimes filtered through a sediment bag before draining or pumping it out of the tower.

### Runoff Procedure

**IT IS CRITICAL TO USE THE PROPER PUMP SYSTEM WHEN HANDLING LIQUID CORROSIVE PRODUCTS**

**NEUTRALIZING REACTIONS ARE EXOTHERMIC, REQUIRES CONSTANT MONITORING**

**DO NOT ATTEMPT TO SLURRY PUMP PHINISH-S or PHAZE**

1. Rinse all tower walls and media

2. Collect runoff on tower bottom (closed drain)
3. Check pH using a pH strip. The runoff will usually be acidic (pH 1.5-6.0)
4. **pHinish-L** - Pump pHinish-L into the tower basin or neutralizing tote. The maximum amount needed is 75% of the volume of the cleaning chemistry (see “Neutralization Table”) used (e.g. 2 gal of pHinish-L per 4 gal of CSR Plus). Start with no more than 1/3 of the maximum amount of pHinish-L required.

**pHinish-S** - When using pHinish-S, the most common mistake is overshooting the pH. This occurs primarily because pHinish-S must first dissolve before the neutralization reaction occurs thereby resulting in a delayed reaction and overshooting. The way to combat this is to first mix 4-5 lbs of pHinish-S in a 5-gallon bucket with 4-5 gallons of water. Always wear PPE and perform the operation slowly because the dilution reaction is exothermic (significant heat generation - the water could rapidly boil if improperly mixed). When pHinish-S is in solution it will neutralize the runoff almost instantly and completely making your pH checks more accurate.

**pHaze** – This product is buffered and dissolves quickly. There is no risk of overshooting the pH, therefore it may be applied in its dry form. In confined spaces, the use of pHaze poses a risk of suffocation as it evolves carbon dioxide gas during the neutralization reaction. Neutralize outside of the confined space whenever possible. If neutralization must be performed in the confined space, adequate air movement and exchange must be provided for. A personal oxygen gas meter should always be used.

5. Mix the runoff in the tower using a pump, fire hose or squeegee
6. Check pH and add neutralizer until pH is above 6.0 – **then stop\*** [Note: add neutralizer outside of tower if possible to avoid recontamination with precipitated particles]
7. If de-chlorination is required before disposal (for storm drain discharge), spread sodium thiosulfate across the surface of the runoff at approximately 5 oz. (140 g) per 1,000 gallons of runoff – mix
8. If filtration is required for storm drain discharge, attach a filtration dirt bag to pump discharge hose and pump the runoff through the bag. The bag can be disposed of in any landfill.
9. Rinse and drain or pump out the tower basin.

\* A strong neutralizer such as pHinish-L or pHinish-S can easily cause the run-off to become highly basic, therefore care must be taken not to over dose.

## Neutralization Tables

The following tables can be used to determine the maximum amount of neutralizing chemical needed to neutralize a unit volume of Blue Earth Products cleaning chemistry.

	pHinish-S (lbs )	pHinish-L (gal)	pHaze (lbs)
1 gal mix - CSR Plus® w/Floran® Catalyst	1.32	0.50	3.29
1 gal mix - Top Ultra® w/Floran® Catalyst	2.01	0.76	5.03
1 gal mix - Filter Fit® w/Floran® Catalyst	2.01	0.76	5.03

**Table 1** – Neutralization conversions for acidic cleaning solutions (max amount required).

	pHinish-S (lbs )	pHinish-L (gal)	pHaze (lbs)
1 lbs - Media Master®	0.40	0.15	0.99
1 lbs - Media Master® RR	0.30	0.12	0.76
1 lbs - neXt®	0.28	0.11	0.70

**Table 2** – Neutralization conversions for acidic cleaning solids (max amount required).

## Final Tower Disinfection (if required)

### Disinfection according to AWWA Standard C 652-92

1. Prepare a chlorine solution of at least 200 ppm free chlorine. This is equal to 1 cup of 10% (available chlorine) NSF Standard 60 bleach in 15 gallons of water. Bleach (same as sodium hypochlorite solution) can be obtained in different strengths. Make sure to adjust bleach dosage to strength (e.g. double the dosage for 5% bleach).
2. Spray the mixture onto every surface that comes into contact with water. Include all plumbing the ladder and your boots. Spray the insides of inflow/outflow pipes as far as possible. Pour remaining bleach into inflow/outflow pipe(s).
3. Exit tower and close manhole. The tower should sit empty for 30 minutes before re-filling.
4. Sample and report Bacteria Testing (BaT) as required by regulatory agencies.

## Quality Control Measures

1. Take photos of the tower before and after treatment.
2. Compare water quality data upstream and downstream of tower as well as tower flow characteristics before and after cleaning.
3. Have a certified tower inspector prepare a tower inspection report to identify repair needs and condition structural materials.
4. Perform complete laboratory analysis of rinsate and solids (part of discharge procedure).



## Benefits and Results

1. Complete removal of surface deposits from all tower surface materials
  - Removes disinfectant demand and contribution to disinfection byproduct (DBP) generation and improves treated water quality
  - Water quality improvement from elimination of water-borne surface contamination
  - Reduction or elimination of risk of microbiological corrosion (MIC) and under deposit corrosion
2. Improved tower inspection:
  - Early detection of paint coating failure and corrosion, extended paint coatings lifetime, clearly visible tower surfaces
  - Non aggressive towards materials used in water tower construction
  - No surface damage from high-pressure spray applications and brushing of surfaces
3. Low labor and downtime for cleaning
  - Treatment of all surface areas without need for scaffolding
  - Reduces out of service time
4. Improve removal rates of volatile compounds
  - Increases surface area to volume ratio
  - Reduces average droplet size and film thickness

## Important Safety Notice

You are working with corrosive chemicals. These can be acids, caustics or oxidants. The products used can do harm through contact with the skin and eyes, ingestion and inhalation. The products are certified for use in drinking water facilities under Standard NSF-60. This means that they do not pose a health risk for drinking water customers if applied properly. This does not mean they do not pose a risk for those who apply the products.

Flush immediately if you come in contact with any of the chemicals. The neutralizer of choice can cause long-lasting, slow healing burns and severe eye damage. (The use of pHaze™ can help eliminate the hazards of handling hazardous caustic products). Avoid contact and flush extensively if you get splashed. Do not ignore any small contact even if it does not burn immediately.

1. Review all Safety Data Sheets (SDS) for the products to be used prior to starting.
2. Find out the local emergency phone number that is used at the water plant in case you need medical attention.
3. Install a garden hose equipped with a nozzle as an emergency water supply. Leave water turned on and place nozzle where it can be easily reached. Use this for rinsing if you come in contact with any chemicals.