White Paper

Controlling Odors in Wastewater Treatment Ponds

3 Successful Approaches to "Stop The Stink" with Floating Wastewater Mixers

Floating wastewater mixers are a proven odor control strategy for many types of wastewater ponds and basins.

White Paper Overview: This white paper will briefly explore the unique characteristics of floating wastewater mixers and how they can help control odors in the following three types of wastewater treatment ponds:

1. Equalization Basins
2. Deep Industrial Storage Ponds
3. Anaerobic Ponds

When working to solve odor problems in these types of ponds, a few investigative questions can be helpful to get you to the solution for your particular scenario.

- How was the pond designed?
- Has the pond changed over the years?
- What is the purpose and operational theory of each pond? Have ponds been added or closed?
- Why are odors apparent on some days and not others?

A better understanding of the "hows" and "whys" of your system will help provide important clues to successfully solve odor problems in a variety of wastewater treatment plants.

Odor Overview: All organic material contains sulfur (a chemical element necessary to sustain life).

Sulfur in the aerobic digestion process is converted to odorless sulfate in the presence of oxygen.

Sulfur in anaerobic digestion becomes sulfide and can exist in several forms such as hydrogen sulfide, mercaptans and thiols. The odors associated with sulfides are diverse ranging from garlic to rotten eggs and worse!

Wastewater treatment plant operators may rate the odors coming from their plants from mild to offensive depending on the number of complaints received from nearby residents.

Operators have several options for to deal with pond odors. They can increase aeration, apply chemicals to the water or apply perfume to the air; however, these solutions are often expensive and not totally effective.

Floating Wastewater Mixer Overview: Over the past 20+ years, floating wastewater mixers have emerged as an effective and economical solution for controlling odors in many wastewater ponds.

Floating wastewater mixers are deployed on the pond surface and can operate completely on grid-power, completely on solar-power or a combination of both. These machines utilize an extremely efficient power control system with a brushless DC motor and an axial flow impeller. They pull water up from an adjustable-depth intake to the surface where its flow is directed outward 360 degrees.

Floating wastewater mixers are different from any other reservoir equipment in that they take advantage of the manner in which water forms thin horizontal layers in ponds and allows a precise horizontal cross-section of water to be mixed throughout the entire pond footprint. The "mix zone" can be indexed to the top of the pond (i.e. setting the intake to mix only the top X feet or set to the bottom to mix the entire pond depth).

1) Equalization (EQ) Ponds: The odor control goal in an EQ basin is to keep the pond well-mixed and aerobic. *(see Figure 1)*

An equalization pond in front of a wastewater treatment plant acts as a shock absorber by temporarily holding excess inflow during rain events until the water can go through the treatment plant.

For example, an equalization basin may be designed to hold eight million gallons of water at eight feet deep (2.5m) when full but it is normally operated with only two million gallons (7571 kL) at a depth of three to four feet (~1 m). Under normal conditions, one million gallons per day enter the pond and a corresponding one million gallons (3785 kL) go through to the treatment plant. During a heavy rain event, the equalization pond may quickly fill to eight feet (2.5m) then lower down to back three feet (1 m) a few days later as the treament plant catches up.

Without thorough mixing, the organic solids entering the equalization pond will tend to settle to the bottom. Over time, the anaerobic digestive process occuring at the bottom of the pond can create ongoing odor problems.

EQ Pond Odor Control Strategy: By keeping the solids and water thoroughly mixed, solids move to the plant instead of settling out. The detention time of both the water and the solids becomes too short for the anaerobic process to ever pick up any momentum. And without anaerobic digestion occuring, odor problems are averted.

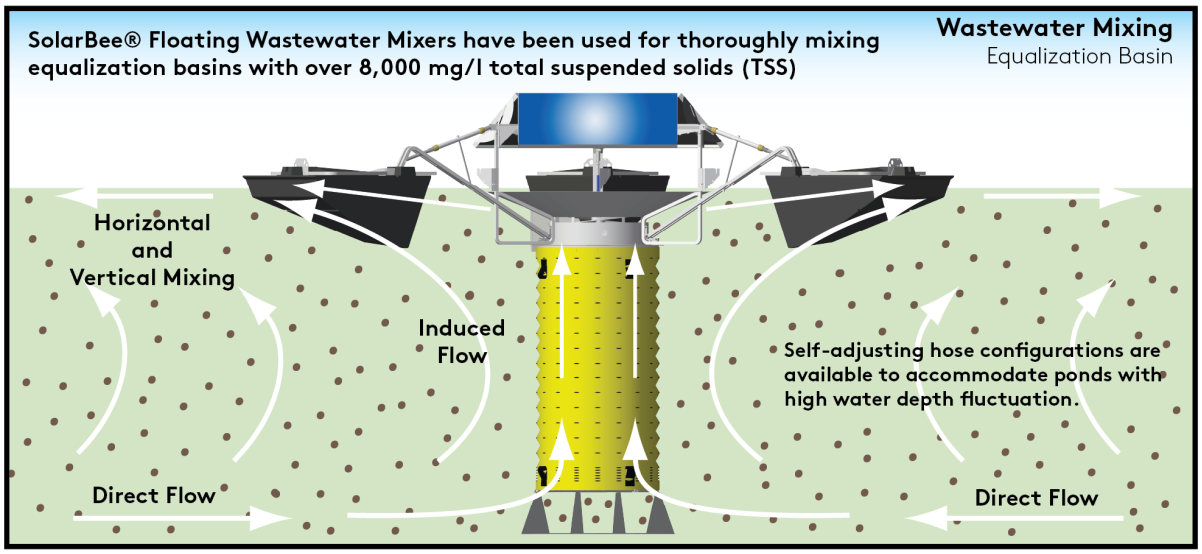

Figure 1- Set the intake near the bottom to keep solids suspended. Self-adjusting intake hose configurations are available to allow full mixing as the pond depth fluctuates.

2) Deep Industrial Ponds: The odor control goal in a deep anaerobic pond is to constantly de-gas to the atmosphere. ***(see Figure 2)***

Some industrial wastewater ponds can be quite deep (upwards of 30 to 50 feet, 9 to 15 meters) and may contain mostly mineral and salt based wastewater (i.e boiler blow-down water from a power plant). Mining ponds and oilfield wastewater ponds can also have this problem.

In these types of ponds, sulfate is introduced with incoming water and other minerals as opposed to being released during digestion of organic material. In the anaerobic environment at the bottom of the pond, some sulfate is converted to sulfide and becomes trapped in the cold, high-salt, high-density water at the bottom. When the pond experiences "turnover" and goes into full mixing mode, a huge amount of sulfides can be released into the atmosphere.

Turnover: When water column temperatures converge to create a full depth mixing condition. This usually occurs in the Spring & Fall but can happen anytime of the year under the right conditions.

Deep Pond Odor Control Strategy: For this situation, it is best to deploy one or more floating wastewater mixers with the intake set all the way to the bottom. The deep, dense water containing dissolved hydrogen sulfide is continuously drawn up to surface where it is depressurized and vented into the atmosphere.

The sulfide smell is most often noticeable only at the mixer but not at shore. When a turnover occurs in the future, there is little to no odor event because sulfides have been and are continuing to be actively vented and minimized.

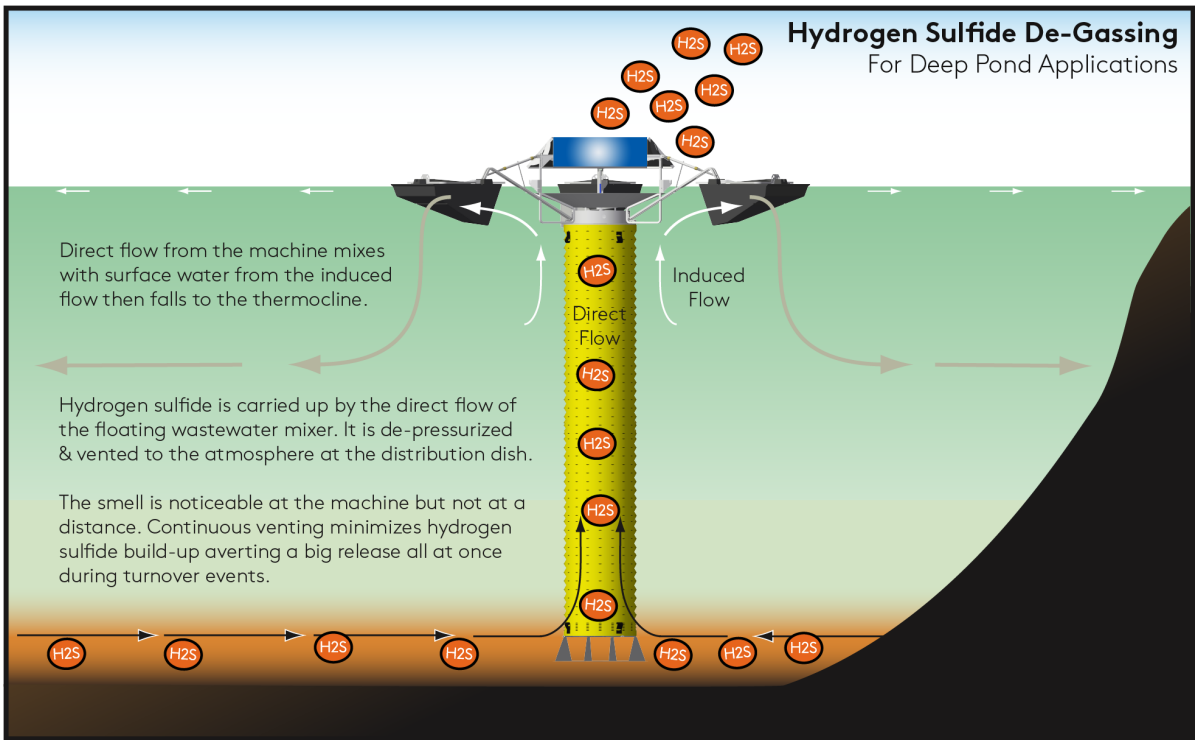

Figure 2- De-gassing a deep-water industrial pond by setting the intake all the way to the bottom. Deep dense water along with hydrogen sulfide is continuously drawn up to the surface of the pond where it will de-pressurize and vent into the atmosphere.

Anaerobic Ponds, Ponds With Anaerobic Layers: The odor control goal in an anaeraobic pond is to form and maintain an "odor-cap". ***(see Figure 3)***

Some wastewater treatment ponds (i.e. waste sludge storage ponds in activated sludge systems) are purposely designed for anaerobic digestion and thus produce sulfides and odors continuously throughout most of the pond depth. To eliminate odors emanating from these ponds, operators can maintain an oxygenated layer of water at the surface of the pond sometimes referred to as an "odor cap." When sulfide gas bubbles rise, they are instantly oxidized to non-odorous sulfate as they pass through the oxygenated "odor cap" layer.

What is an Odor Cap? An odor cap is an oxygenated surface layer of water which can stop odorous compounds from escaping into the atmosphere. An odor cap layer as thin as one inch (2.5 cm) is all that is required to neutralize sulfide odors; however, an odor cap this thin can be easily disturbed by wind. Once the odor cap is broken, odors can easily escape. It is usually best to create a more robust and dependable odor cap of 1-3 feet (0.5-1.0 m)

Anaerobic Odor Control Strategy: Some floating aerators (i.e. brush aerators) have a shallow, mostly horizontal mixing effect. Many times these are the best type of aerator to use to create an odor cap on an anaerobic pond but there is a problem. Because they generally send out a turbulent, mono-directional flow which can reach several feet deeper than desired, they also tend to bring up deep BOD (biochemical oxygen demand) material into the odor cap zone. This in turn causes oxygen depletion at the surface which can reduce or eliminate the ability to

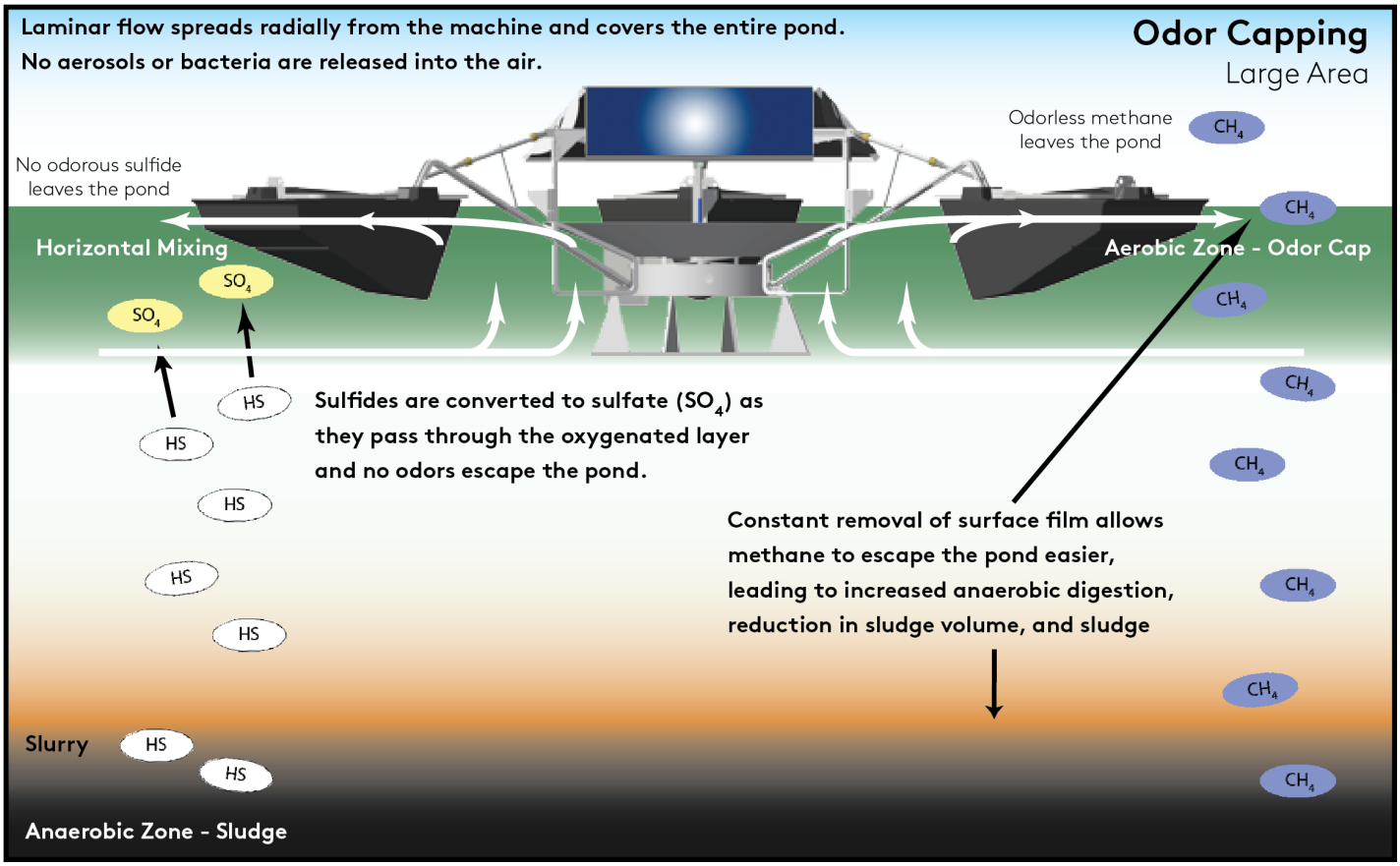

Figure 3- Odor cap an anaerobic pond by setting the machine to mix only the top 1-3 feet (0.5 - 1.0 m). This will effectively "cap" the anaerobic waters below with an oxygenated surface zone keeping odors at bay.

control odors. In addition, several aerators in each pond are often needed to supply enough oxygen to maintain the odor cap resulting in higher capital and operating costs.

Floating wastewater mixers are a more ideal solution for creating an odor cap. They have adjustable intakes that can be set at a desirable depth according to the particular needs of an application (usually 1 to 3 feet, 0.5 to 1 m). They create a 360° flow pattern reaching to the edge of the pond or reservoir.

Dissolved oxygen in the odor cap is maintained through two mechanisms:

(a) capture and distribution of photosynthetic oxygen during the daylight hours; and

(b) surface re-aeration during the nighttime hours.

By efficiently mixing and distributing available dissolved oxygen in a horizonatal and near-laminar fashion, floating wastewater mixers can create a very effective odor cap throughout a set surface zone.

Additionally, turbulence free flow attributes with specialized intake designs will not bring up any BOD loading from deeper water. All these factors together help to maintain a reliable odor cap 24 hours/day.

! Critical Influent & Effluent Considerations !

No matter the type of equipment used to create and maintain an odor cap on an anaerobic pond, three practices are critical for odor control success.

1. Influent to the pond should be kept below the odor cap so that incoming BOD does not use up the oxygen in the odor cap. If the odor control plan calls for a 3 foot (1 m) thick odor cap, the inflow should be brought in horizontally at four feet (1.3 m) or deeper.

If an old pond is converted to sludge storage and the horizontal inflow pipe is not deep enough, a baffle or 45-degree elbow with a short pipe extension can be added to ensure inflow water comes in below the odor cap zone.

For ponds where influent water enters vertically at the bottom of the pond, a deflector (similar in shape to a card table) can be placed over the influent pipe. This will force incoming water into a horizontal pattern instead of shooting up to the surface of the pond (helping to keep the odor cap intact).

2. The effluent from the pond should be drawn from below the odor cap zone. This prevents the odor cap from being drained off the pond. If an old pond is being converted to use for sludge storage and it has a skimming outlet pipe, devise an anti-skimming baffle or 45-degree elbow with a short pipe extension to ensure water leaving the pond comes from below the odor cap zone.

3. The influent to the pond cannot be hot water. Hot water will float across the top of the pond and the BOD in it will use up the oxygen in the odor cap. For this reason, odor capping can be difficult in some industrial treatment applications (i.e. beef processing where the influent is hot wash-down water). For these "hot water" ponds, aerobic digestion of all influent is one solution or the pond can be covered to achieve odor control.

Conclusion: Diagnosing odor problems in wastewater treatment plants is an intriguing process and it begins with a thorough investigation of the plant, its processes and purposes.

Just as each plant is unique, each solution is unique as well; however, many pond odor problems and solutions will fall into one of the three wastewater pond types discussed above.

Floating wastewater mixers are proven and valuable tool in both aerobic and anaerobic applications. They can often be installed & operated at a fraction of the cost of other methods yet operate compatibly with existing aeration systems.

Treatment plant operators will discover it is worth their investigative time to consider floating wastewater mixers as part of their odor mitigation strategy.

