REGARDING ON-SITE SLUDGE DIGESTION ISSUES

As those who manage and/or operate waste treatment facilities of one sort or another, at the end of the process all are faced with that age old question – What now? How do we get rid of the finished "by-products"? We have several options among which are deep-well injection, holding and polishing ponds, or discharge into an existing body of water be it a stream, lake, or even the ocean. No matter which method we are using, all of them require us to deal with the sludge generated in the process or processes. As if we didn't already have enough of a challenge, we are now faced with one that is an additional political and technical challenge with a usually expensive or onerous solution in some way.

These things all have commonalities, so let's begin by addressing how we treat sludge in holding ponds as a start. We may dredge the sludge ponds to ameliorate the situation, but we are merely transferring the problem off-site, adding expense to the process, involving State and/or Federal agencies in regulation of this operation (more so than we would wish), or be denied outright by local authorities to even perform this operation. We can pump the sludge to another location, but the problem still exists, and we have more additional expenses incurred. We can de-water the sludge and dispose of it in some other way such as mining it for mineral content, using it as a feed source for livestock, using it as a fertilizer, or just reducing the volume of it. Even if we are able to perform this operation efficiently and the operation is allowed by the regulatory authorities and permitting is approved, we still have more problems – additional drying, hauling it off, shipping it to some other location – and all of these impact

our operations economically. No matter how we address this matter, in every single case we have to "bite the bullet" on testing requirements, on costs incurred in the permitting process, on the various maintenance costs as well as the manpower costs, and on variable costs such as energy usage and equipment degradation over time. Therefore, any viable solution to this problem would either have to eliminate many of these considerations or, at the very least, markedly affect their economic impact.

The very first thing that we can address is the need for on-site processing of the sludge to minimize off-site transport. If our technologies cannot completely eliminate this, they at least must have a substantial effect in cost reduction in this regard. It is to this question that the engineers and designers of DO2E have addressed their efforts. In order to understand our rationale, we must first examine the nature of sludge.

Sludge is the detritus remaining after the wastewater treatment process is complete. It is usually a slurry – at times a very compacted one. Sludge consists of organic and inorganic components as well as structures that cannot be treated. Each wastestream has its characteristic sludge residuals. We at DO2E have developed several products that provide a means to alleviate sludge remediation on-site.

Basically, they are broken into two types – Aerators and Digesters of which the modified Digesters used for this purpose are marketed as Aerating Mixers. The Aerators are designed to aerate wastewater streams, and the Digesters (Mixing Aerators) are designed to aerate as well as render particulates inherent to much smaller

dimensions (surface areas) and hence increasingly susceptible to oxidation. Both of these are OXIDIZERS, and both also rely on providing atmospheric oxygen to remediate slurries. Both also are capable of adding other treatment modes to the problem such as ozone, advanced oxygen processing, and a multitude of chemical reactants to effect a particularly difficult breakdown problem.

Let us consider the "workings" of a typical Aerator. How these aerators work, that is, the mechanism of action, is necessary for an understanding of their many applications. These systems are equipped with a mixing chamber and air manifold system that is exclusive to them. These Aerators draw water at a depth of 46" (3.833' or 1168 mm), sending it through the air-mixing chamber. It is injected with atmospheric oxygen there, and the effluent is then discharged into the surface column of water. This mixing enables destratification of the liquid column.

Regenerative Air Blowers are employed as the source of air. Low pressure, high volume air flow is used for injecting atmospheric oxygen. The combination of increased injection air pressure at this depth and the equilibrium water pressure enable maximum efficiency of O_2 transfer per HP/hour (up to 7 lbs. O_2 per HP/HR).

A combination of coarse and fine air bubbles is used for dual reasons: (1) The fine bubbles result in maximum O_2 transfer, and (2) the coarse bubbles increase the velocity at which the air bubbles traverse the mixing chamber. The velocity of the water moving through the mixing chamber is related to blower output and manifold modifications. This velocity further increases the oxygen transfer. As the bubbles travel up and out of the chamber, the void created

is filled with water entering from the bottom of the chamber, creating a Venturi (vacuum-type) system. Design modifications to shield these Venturi "drivers" from being "ragged" up have been added to further enhance their versatility.

This oxygenated water increases in density, and the horizontally-directed effluent from this stream results in a deep-water drawing effect. The specific curvature of the mixing chamber results in this effect as the directed effluent stream exhibits components that result in the momentum of the effluent column being projected both horizontally and vertically.

This results in these Aerators drawing water in from lower water levels, injecting it with atmospheric O_2, and discharging it horizontally at the surface. The Aerobic Mixers (which really are suspended Digesters) are used primarily to break down sludge particulates while aerating them. The Aerators, too, breakdown particulates in the sludge as a result of collisions engendered and the extreme turbulence. These units are sized for a particular job which may result in highly variable velocities depending on the blower size, the depth of draw, the temperature, the viscosity of the medium addressed, and even what the final outcome is intended to be. These units may be modified to deliver what is necessary under a variety of initial conditions. We are all familiar with the Hippocratic Oath that physicians take: "First, do no harm." We can extend this idea a little further in the use of various devices for remediation purposes: "Make sure that the cure is not worse than the disease."

Most remediation problems involving water impoundments involve toxic sludges and heavy metals, odor-causing compounds, algal blooms, nutrient overloads, and other issues in which dissolved oxygen (and ozone) can be used to increase the progress of the deterioration, sequester certain dangerous ions in insoluble forms, and generally improve water quality. When we use the term "remediation", it may actually be a "catch-all" term for addressing sludge problems. The final solution to these sludge deposits is the conversion of the organic components into CO_2 and water as well as the formation on non-reactive inorganic compounds (usually oxides), both of which are handily done by the DO2E Aerators and Aerobic Mixers. Removal of these troublesome deposits may be addressed further by PeriFilter technology or other liquid/solid separation devices.

The Aerators as well as the Mixing Aerators can address these issues with minimal energy expenditure. They are ideally suited for employment in this treatment at on-site applications of the technology as they are mobile, moveable, safe, easily operated, and real energy "misers". The resulting sludge removal will be determined by the on-site users and by the actual waste sludge that is being encountered. Once it is in processable form, a lipid/solid separation technology can be employed. Our position is that the PeriFilter technology offers the most "bang for the buck" in this regard.

In additional material to follow, DO2E will provide explanations regarding the use of advanced oxygen processing (O_3 + free-radical OH^- ions) for further on-site usage to attack and remove the sludge deposits.