# ENDOTOXIN DEGRADATION WITH OZONE

Endotoxin are liberated during the destruction (cell lysis) of gram Negative Bacteria especially pseudomonas and some cyanobacteria strains. Endotoxin is lipopolysaccharides commonly known as LPS or Pyrogens . They are organic micro pollutants also classified as emergent contaminants. They cause ill effects on humans. Years ago, presence of Endotoxin was only considered in water for injections, infusions and other intravenous solutions. They are known to cause rigor and pyrexia (fever) in patients during intro venous injections and infusions. At present the presence of endotoxin is being regulated in potable water too and we could see more stringent regulations in the near future

**Characteristics of Endotoxin:** They are known to be resistant to even high temperatures. They can survive 120° temperature for more than 1 hour. They are resistant to chlorine and UV. They can be filtered by UF but have known to pass through them at times. They can also become sessile and lodge themselves to Bio fouling material which protects them from destruction.

**Concentration of Endotoxin:** For intravenous infusions, water for injections, Dialysis water etc, the levels allowed is not more than 0.25 EU/ml. But in drinking water, there are reports that the content of endotoxin can be sometimes as high as 1000 EU/ml. Hence there is a requirement for more stringent controls.

**Degrading /detoxification of Endotoxin:** At present, many methods of oxidation are available, use of Hydrogen Peroxide, Per–acetic Acid, permanganate solutions. In haemodialysis, I addition they use hypochlorite, formaldehyde and heat. The issues with these oxidation agents are their effectiveness in the removal of bio fouling. Since the presence of Endo Toxin is also in correlation to the presence of primary and secondary bio fouling, it is imperative that bio fouling is also addressed for long term solutions.

**Ozone the Saviour:** Ozone has been accepted as one of the better and more reliable oxidant for detoxification of endotoxin. The USFDA has approved the use of ozone under FDA 510 (k), for use in medical haemodialysis as an acceptable oxidant in water treatment . Ozone's acceptability is on account of its superior oxidation when compared to other known chemical oxidants. It leaves no residue behind and is extremely safe oxidant. Oxidation residues can contaminate the water at a later stage unlike other oxidants, ozone is very effective in the removal of Bio fouling in tanks, pipes, and other storage vessels and distribution loops. Note that secondary bio fouling materials are easily removed, but primary bio fouling would take some time, may be months.

In haemodialysis water and for ultrapure phrama water, it is always advisable not to have storage tanks as, the more we store the water the more likely that we get endotoxin contamination. In case of unavoidable storage facility in the distribution loop, it may be required to have continuous ozonation in the loop to avoid recontamination, and not allowing endotoxin to go into sessile mode. Continuous ozonation will also ensure no bio fouling takes place.

In Haemodialysis water, Ozone is always introduced in batch mode to ensure reliability. The loading dose is high when compared to residual ozone we try to achieve. Contact time required is longer than the normal time required. These precautions enhance reliability of the process. For Haemodialysis water, it is advisable to stop the ozonation one hour before use, and then destroy the ozone with UV lamps of appropriate design. The ozone mass transfer should take place through very small micro bubble sizes, as it has been noted that large bubbles can protect these endotoxin from ozone actions.

In both hospital and pharmaceutical environment no ozonation must take place without an appropriately designed ozone destructor and ambient ozone control in plant room. Locally designed ozone destructors offer economical solutions to the client, but are never reliable and not safe and could pose danger to plant room operators when they can cause implosion of the contact tanks.

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