Redox potential, an indicator of aquaculture pond health

Pond environment is crucial in the outcome of aquaculture operations. As the culture period progresses, the pond bottom condition deteriorates due to accumulation of organic matter residues. This leads to high oxygen consumption and the development of reducing (anaerobic) conditions in the pond bottom. When reduced species are building up, the pond condition is termed "REDUCED". This condition leads to the diffusion of toxic reduced compounds from the bottom soil upward into the water column, high sediment oxygen demand, deterioration of the pond environment and adverse effects on shrimp growth.

What are the indicators of pond bottom condition?

- Redox potential also called as oxidation-reduction potential (ORP) is an important parameter to measure the relative degree of oxidation and reduction in aquaculture ponds. ORP in the pond soils decreases towards reduction (more negative side) with progress of culture period. Though highly variable, ORP values denoted by E_h and quantified in milli volts (mV) are the best used as an indicator to understand the relative status of the soil.
- Organic carbon (OC) content of soil is another index of pond sediment condition. High OC values imply more organic matter accumulation on pond bottom. The organic matter comprises a large fraction of stable, slowly degradable OC and hence, it is not a sensitive indicator. Conventional soil organic carbon determination procedure includes exposing the soil to air drying and analysis has to be done in the laboratory.

- Concentration of soluble iron and manganese (reduced species) is more sensitive indicator of the redox conditions. The soluble forms of the reduced species of ferrous or manganese ions (2^{+}) in the pond bottom soils are to be analysed.
- Though OC and reduced element species content can be used as indicators for pond bottom deterioration, estimation of OC takes more time and hence cannot be used as quick indicator to plan management practices for improvement of pond bottom condition. It is possible to evaluate the intensity of the pond anaerobic conditions by measuring the sediment redox potential. Hence, redox potential is considered as one of the important, instant and better indicators that can be used to understand the deterioration of pond bottom sediment.

In intensive shrimp culture ponds, the accumulated black sludge in the pond bottom leads to reducing conditions and negative redox values. CIBA studies have revealed that ORP value of -200 mV or more is not desirable during the culture period as this negative redox potential reduces dissolved oxygen levels, increases metabolites (ammonia and nitrite) concentration and also generates reduced compounds like sulphide, methane etc. This problem can be avoided by following better management practices such as optimum stocking density, providing proper aeration uniformly throughout the pond by placing aerators at right place, chain dragging along the pond, central drainage system and disposal of sludge through heavy duty pumps.

How to measure redox potential?

Measurement of redox potential of sediment near sluice gate and away from the aerators at any point of time during culture period gives the early indication of pond bottom deterioration. The following protocols are recommended.

ORP can be measured at soil water interface (SWI) near sluice gate and away from the aerators by portable multi parameter analyser with ORP probe.

If probes are not available, the sediment sample at 10-cm depth is to be collected in a polythene bag under air tight condition near sluice gate and away from the aerators. Once the sample is brought out of the pond, immediately ORP has to be measured under air tight condition by using a portable/bench top redox meter.

In order to minimise the errors of ORP variability, minimum of three sampling places have to be fixed near sluice gate and repeated measurements are to be taken at each sampling place (SWI or 10-cm depth soil in polythene bag) and the average value can be taken as final value.

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