High Density Polyethylene (HDP) sheets are used for both bioreactors (Conventional and Novel bioreactor), and the thickness of the sheet was 5 mm. Height (30 cm), width (20 cm) and length (20 cm) were same of both the bioreactor, but the surface area of conventional reactor was 400 sq. cm and novel bioreactor surface area was 313.76 sq. cm, because 86.24 sq. cm. is covered by baffles. Inside of novel bioreactor, two types of baffles are designed as half circular and small square. Half circular baffles cover 50.24 sq. cm and small square baffles cover 36 sq. cm area from the total surface area 400 sq. cm, but the working volume of both bioreactor were maintained the same 7 liter, same way feeding volume in each bioreactor also maintained the same i.e. 2 liter. After maintaining working and feeding values same of the both bioreactor than automatically other operating parameter as the flow rate of the effluent in bioreactor, retention time of both bioreactor also maintained same. Pilot plants of both bioreactors are shown in the figure no 4.6 & 4.7, and using stirrer and their impeller’s position is shown in the figure no. 4.5 (A & B). 2800 rpm motors are used for aeration in both bioreactors, but the impeller positions of the stirrer are different. In novel bioreactor, two impeller of the stirrer are used, first impeller position was 6 cm and the second impeller position was 13.5 cm from the bottom of the reactor whereas in conventional bioreactor only one impeller was used, their position 6 cm from the bottom of the reactor.
Figure no. 4.5 (A & B), shows the surface aerator of both bioreactors

Working mechanism of novel bioreactor-

In the novel bioreactor, inside baffles are constructed, and the two impellers are used one at the surface and the other at the bottom. When the stirrer starts then effluent also starts circulating in the same direction. Due to the presence of baffles in the bioreactor, the effluent generates more bubbles and it gets more aerated.

At the same time the bottom impeller of the stirrer helps to mix the effluent homogenously and activates sludge uniformly. From the experimental work finally concluded that the mechanism of the surface aerator (impeller) helps to increase oxygen rate in the effluent and the bottom aerator (impeller) helps to improve growth rate of the microbes in the reactor.

Working mechanism of conventional bioreactor-

The mechanism and the design aspect of conventional bioreactor is too simple i.e.
1) No baffles are constructed inside the reactor.
2) Only one stirrer impeller is used.

Due to this design, aeration is very less as compared to the novel bioreactor. The bottom effluent is not mixed properly hence the mixing of sample and the addition of aeration never takes place properly at the bottom of the reactor. Therefore, the activated sludge remains untreated in the reactor; hence this type of condition creates anaerobic condition at the bottom of the reactor. After chemical treatment process, the effluents are treated biologically treatment with the activated sludge. Feeding effluent characterized continuously for a period of one year, selected parameters as pH, TSS, TDS, COD, BOD, Oil and grease, PO₄, Cu, Cr, Zn, Fe, Pb, and Ca data is presented in the table no.4.3. In each bioreactor 2 liter per day feeding effluent was used.

Both the bioreactor effluents are analyzed, selected parameters of both the bioreactor like pH, SVI %, TDS, COD, MLSS, MLVSS, DO, OUR, PO₄, Cu, Cr, Zn, Fe, Pb, and Ca data is presented in the table no.4.4 and 4.5, difference in each parameters of both the bioreactor are also given in the table no. 4.4 and 4.5. After biological treatment, effluent is passed to the secondary clarifier, and then the outlet effluents are also analyzed of both bioreactors. Parameters like pH, TSS, TDS, COD, BOD, Oil and grease, PO₄, Cu, Cr, Zn, Fe, Pb, and Ca are recorded. Differences in each parameter of both bioreactors are shown in the table no. 4.6 and 4.7. After completing all the treatment process, the obtained sludge of biomass is collected and dried. The quantity of biomass and concentration of heavy metals are recorded, and they are presented in the table no. 4.8 and 4.9.