SUMMARY

The present investigation highlights the physico-chemical properties of lime sludge waste of Jagiroad Paper Mill and the impact of lime sludge waste on the physico-chemical properties of the water and soil and also on the growth of fish and plankton.

1. The pH of lime sludge waste is slightly lesser than that of the marketed lime. So, lime sludge waste can be used as liming material in fish farming since it has high pH value and it will help in increasing the pH of the acidic water.

2. The water holding capacity of lime sludge waste was found to be 70.43% so it can be used in the soil to increase water holding capacity which has low water holding capacity.

3. The organic carbon content of the lime sludge waste was found to be 0.12% so it can be used in the soil which has low organic carbon.

4. The percentage of Calcium Carbonate (CaCO₃) in lime sludge waste was found to be 66.5%. And so, it can be used in the soil which has low calcium carbonate content.

5. The chloride content in lime sludge waste was found to be 560ppm and the available phosphorous content in lime sludge waste was found to be 0.078ppm.

6. The available calcium present in lime sludge waste was found to be 494.0ppm and the available sodium content in lime sludge waste was found to be 30.0ppm.
7. Amount of heavy metals present viz. Pb, Mn, Cu and Zn were within the permissible level. Among different metals the mercury (Hg) is highly toxic and it was revealed from the study that lime sludge waste does not contain this very toxic metal.

8. The required dose of lime sludge waste is 1.5 times more than that of pure lime or marketed lime to maintain pH within desirable range.

9. The pH of the aquatic media was found to increase after addition of lime sludge waste in experimental aquarium. Like pH all the other physico-chemical properties of the aquatic media were found to increase after applying the lime sludge waste.

10. The fishes (Indian Major Carps viz. Catla catla, Labeo rohita Cirrhinus mrigala and Labeo bata) cultured in the lime sludge mixed water in experimental aquarium showed normal growth. There is no toxic impact of lime sludge waste on the growth of fishes.

11. The pH, specific conductivity, total alkalinity and total hardness were found to increase gradually with increasing the concentration of lime sludge waste (0%, 1%, 2%, 5% and 10%) in the experimental beaker.

12. In the present investigation period six genera of phytoplankton belonged to four groups namely Myxophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae were observed. Out of which, one genus belonged to Myxophyceae, two Chlorophyceae, two Bacillariophyceae and one Euglenophyceae. Five genera of zooplankton representing four groups namely
Protozoa, Rotifera, Cladocera and Copepoda were observed. Out of which, two genera belonged to Protozoa, one Rotifera, one Cladocera and one Copepoda.

13. Among the phytoplankton the population of Chlorophyceae was highest in all the concentrations followed by Myxophyceae, Bacillariophyceae and Euglenophyceae during the course of the investigation.

14. Among the Chlorophyceae mainly *Ankistrodesmus* and *Volvox* were observed. Among the Myxophyceae mainly *Ostillatoria* was observed. The different genera of Bacillariophyceae observed in the present investigation were *Navicula* and *Pinnularia* and among the Euglenophyceae mainly *Euglena* was observed.

15. Among the zooplankton the population of Protozoan species was highest in all the concentrations followed by Cladocera, Copepoda and Rotifers during the course of the investigation.

16. Among the Protozoan species mainly *Paramoecium* and *Vorticella* were observed. Among the Cladocera mainly *Daphnia* was observed. One genera of Copepoda observed in the present investigation was *Cyclops* and among the Rotifers mainly *Brachionus* was observed.

17. It was revealed from the study that the growth of plankton is greater in the lime sludge waste mixed beaker than the control i.e. the beaker water in which lime sludge waste was not added. It was also revealed from the study that the increase in the concentration of lime sludge waste favoured the growth of plankton. The percentage of growth is greater in concentration 5%.
18. Lime sludge waste of paper mill has a positive impact on the growth of plankton and it has no toxic impact on the plankton, rather it is good for the growth of plankton.

19. When the concentration of cow dung were increased (0%, 1%, 2%, 5% and 10%) all the physico-chemical properties of the aquatic media were also found to increase. During the investigation eight genera of phytoplankton belonged to four groups namely Myxophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae were observed. Out of which, two genus belonged to Myxophyceae, two Chlorophyceae, three Bacillariophyceae and one Euglenophyceae. Six genera of zooplankton representing four groups namely Protozoa, Rotifera, Cladocera and Copepoda were observed. Out of which, one genera belonged to Protozoa, two Rotifera, two Cladocera and one Copepoda.

20. Among the phytoplankton the population of Bacillariophyceae was highest in all the concentrations followed by Myxophyceae, Chlorophyceae and Euglenophyceae during the course of the investigation.

21. The different genera of Bacillariophyceae observed in the present investigation were *Navicula*, *Cymbella* and *Pinnularia*, among the Myxophyceae mainly *Ostillatoria* and *Rivularia* were observed. Among the Chlorophyceae mainly *Ankistrodesmus* and *Closterium* were observed. And among the Euglenophyceae mainly *Euglena* was observed.

22. Among the zooplankton the population of Rotifers was highest in all the concentrations followed by Cladocera, Copepoda and Protozoan species during the course of the investigation. Among the Rotifers mainly *Brachionus sp.* and
Keratella were observed. Among the Cladocera mainly Daphnia sp. and Molna were observed. One genera of Copepoda observed in the present investigation was Cyclops sp. and among the Protozoan species mainly Paramoecium was observed.

23. When the lime sludge waste was mixed in different concentrations (viz. 0%, 1%, 5%, 10% and 20%) in 8 litre capacity aquaria, the different physico-chemical properties were found to increase gradually with increasing concentrations of lime sludge waste.

24. It was also observed from the study that after 30 days of exposure of the fishes in the different concentrations of lime sludge waste mixed water there was no toxic effect on the fishes up to 15% concentration, however at 20% concentration all the fishes died.

25. The protein content of the tissues (whole fish) of the fishes cultured in different concentrations (0%, 1%, 5%, 10% and 15%) were found to be 2.920mg/g, 2.653mg/g, 3.973mg/g, 7.386mg/g and 5.106mg/g. The value of protein was found to be highest in 10% concentration of lime sludge waste. The lipid content of the fishes cultured in different concentrations (0%, 1%, 5%, 10% and 15%) were found to be 6.4%, 12.36%, 11.66%, 12% and 9.49%. The percentage of lipid found to be highest in 1% of lime sludge waste. It is revealed from the investigation that lime sludge has no adverse effect on the quality of fish.

26. There is good impact of lime sludge waste on the soil and water quality in experimental ponds and also on the growth of fishes cultured in lime sludge mixed water in ponds.
27. The pH, specific conductivity, total alkalinity and total hardness of the pond water were found to increase after application of lime sludge waste. All the physico-chemical properties were found within the desirable ranges from the fisheries point of view.

28. The pH, specific conductivity, water holding capacity and organic carbon of the pond soil were found to increase after application of lime sludge waste.

29. The fishes ((Indian Major Carps viz. *Catla catla*, *Labeo rohita* *Cirrhinus mrigala* and *Labeo bata*) cultured in the lime sludge mixed water in experimental pond showed normal growth. There is no toxic impact of lime sludge waste on the growth of fishes.

30. In the present investigation, values of ‘n’ for *Cirrhinus mrigala* cultured in the two ponds were recorded as 3.41309 (for fishes cultured in lime sludge mixed pond) and 2.52095 (for fishes cultured in control pond), which were almost same. The values of ‘n’ for *Catla catla* were recorded as 3.55011 (from control pond) and 2.91612 (from lime sludge mixed pond). The values of ‘n’ for *Labeo rohita* were recorded as 2.03511 (from control pond) and 1.99338 (from lime sludge mixed pond). The ‘n’ values of ‘n’ for *Labeo bata* fish were recorded as 1.73629 (from control pond) and 1.79769 (from lime sludge pond). This investigation confirmed that lime sludge waste of paper mill has no adverse effect on growth and development of fish.