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# Use of Resin Based Systems for the Treatment of Wastewater Generated from Educational Institutes

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Private education institutes have come up in a large manner over last few years in north India. Many of these are located over private lands in far- off places and provide for hostel and mess facilities. The pollution control boards are therefore persuading these institutes to create their own sewage treatment facilities. This academic exercise is the research work of author on evaluation of resin based pollution control systems on laboratory scale. The need for this project is felt by the author due to large flow variations in the sewage volumes particularly during holidays which may extend over one month. The traditional sewage treatment systems get disrupted due to low feed in this period. Stabilization of biological systems two or three times in a year is considerable task with the institutes. Trials are undertaken using macroporous poly (vinylbenzyl-trimethylammonium) exchanger, a strong-base anion-exchange resin and macroporous-type anion exchange resin with a polystyrene matrix, a weak-base anion marketed for removal of organic matter. Chemical Oxygen Demand (COD) reduction in the range of 50-60% is observed. With Biological Oxygen demand (BOD) standards for discharge of treated sewage over land being 100 mg/L (milligram per liter) it makes sense in undertaking pilot scale studies on resin based treatment systems for treatment of domestic sewage. The management of educational institutes can tie up with manufacturer's of wastewater treatment systems to undertake such pilot studies and help develop systems that in long are not only economical and easy to operate but also provide excellent resistance to shock loadings.

*Keyword:* Resin Treatment of Wastewater Educational Institutes.

## 1. Introduction

When it comes to sewage disposal educational institutes in cities are lucky. They discharge their sewage into the municipal sewer. The sewage than becomes municipal corporations responsibility. But due to high land cost in cities, private education institutes are come up in a large number in far- off places that do not have public sewers in place. These institutes also provide for hostel and mess facilities. These have sewage generation in the range of 10 to 25 Kilolitres/day (KL/day). The Biochemical Oxygen Demand (BOD) of the sewage generated from the institutes after preliminary treatment (screening, oil and grease traps and grit removal) varies in the range from 100-200 milligram per liter (mg/L) and Chemical Oxygen demand (COD) is in the range of 180-260 mg/L. The pollution control boards are persuading the institutes to create their own sewage treatment facilities prior to discharge over land. The standard for BOD for discharge of sewage for irrigation over land is 100 mg/L (CPCB PCL/4/1995-96). It is 350 mg/L for discharge of sewage into public sewer (CPCB PCL/4/1995-96. However, in cities as in Chandigarh, the Chandigarh Pollution Control Committee has restricted the standard for discharge of sewage into public sewer to 100 mg/L in order to ensure optimal load on terminal city sewage treatment plant.

Initially the educational institutes in far-off lands tried to manage by providing septic tanks. This, however, is found to be unsuccessful as only 25-40 % of the treatment is achieved. Further the effluent from septic tank needs to be further polished using soakage pits. The majority of the institutes failed to provide soakage pits as there were issues related to hygiene and operation and maintenance. The institutes have later shifted to package type secondary sewage treatment plants based on activated sludge process. The package treatment plants in use mostly are working on Moving Bed Biofilm Reactor or MBBR process or Submerged Aerobic Fixed Film Reactors. The BOD levels achieved on secondary treatment are in the range of 20-40 mg/L. There are two types of problems in operation of package type skid mounted units. One is the efficiency is on the higher side and many of the institutes feel that when the standard to be achieved is 100 mg/L, they are unnecessarily treating the effluent to a lower value and thus spending more money on treatment; contrary to which some of the institutes are further polishing the effluent using pressure sand filter and activated carbon filter and reusing for flushing. The other and key problem is that educational institutes have holidays at least twice in a year when the hostel facilities and mess shut done for over 15 to 30 days. This leads to disturbance in the aeration tanks as the inflows reduce to less than 10% of the peak capacity.

The author has done this academic exercise to evaluate the possibility of employing resin based wastewater treatment systems and attempted treatment on laboratory scale using commercial resins.

## 2. Methodology

Trials are undertaken using Purolite A-500P, macroporous poly (vinylbenzyl-trimethylammonium) exchanger, a strong-base anion-exchange resin and Purolite A109 a macroporous-type anion exchange resin with a polystyrene matrix, a weak-base anion marketed for removal of organic matter. Samples of sewage after preliminary treatment (screening, oil and grease removal and grit removal) are collected from different institutes and analyzed for COD. It is determined using the open reflux method (APHA 5220A). The sample is refluxed in strongly acid solution with a known excess of potassium dichromate (K2Cr2O7). After digestion, the remaining unreduced K2Cr2O7 is titrated with ferrous ammonium sulfate to determine the amount of K2Cr2O7 consumed and the oxidizable matter is calculated in terms of oxygen equivalent.

The characteristics of Purolite A-500P and Purolite A109 are listed in Table-1. In addition to ion exchange reactions, macroporous ion exchange resins also show adsorptive properties which are due to the large pores of the resin beads and to the inner surface inside the beads.

The experiments were done at laboratory level using glass columns. The A500P and A109 were filled in glass columns as per manufacturer's instructions and used to run through 100ml and 1000ml sewage. The resins were recharged after each run.

## 3. Results

Ion exchange technology has been widely known for a long time as a reliable method for water softening, which we also use it for, but it is less well known, for contaminant removal. Here, it served that function successfully. The initial COD values and percentage reduction in COD using resins A500P and A109 with 100 ml sewage passed are reported in Table-2 and with 1000 ml sewage passed are reported in Table-3. The initial COD values ranged from 180 -260 mg/L. With 100 mL sewage passed resin A500P provided COD reduction in the range of 50-51% whereas for 1000 mL sewage passed the COD reduction varied from 47-49%.For the resin A109 the COD reduction varied from 52-54% for 100 mL of sewage passed and from 49-52% for 1000 mL of sewage passed respectively. A comparative view of COD reduction after passing 100 mL and 1000 mL of sewage through A500Q and A109 Columns is shown in Figure-1 and Figure-2.

## 4. Conclusions

The ion exchange treatment option using resin A500P and A109 is suggested by Purolite for organic matter removal from industrial and domestic supplies. The results as evident make sense in undertaking pilot scale studies on resin based treatment systems for treatment of domestic sewage. The management of educational institutes can tie up with manufacturer's of wastewater treatment systems to undertake such pilot studies and help develop systems that in long are not only economical and easy to operate but also provide excellent resistance to shock loadings. Other than educational institutes this alternative of treating domestic sewage can also be looked into for marriage palaces which operate only seasonally and at irregular intervals. These have flows only during the marriage functions and thus activated sludge process based plants fail to work. For the pilot studies Purolite may be requested to support and predict the behaviour of the contaminant using its proprietary simulator software. The management of educational institutes can tie up with manufacturer's of wastewater treatment systems to undertake such pilot studies and help develop systems that in long are not only economical and easy to operate but also provide excellent resistance to shock loadings.

**Table 1:** Characteristics of Resins, Purolite A-500P and Purolite A109

| **Characteristics** | **A500P** | **A109** |
|---|---|---|
| Total Capacity | 0.8 eq/l | 1.0 eq/l |
| Moisture Retention | 63-70% | 58-65% |
| Mean Size Typical | 0.60-0.85 mm | 425-1000 µm |
| Uniformity Coefficient (max.) | 1.7 | 1.6 |
| Reversible swelling | 20% | 25% |
| Specific Gravity | 1.04 g/ml | 1.05 g/ml |
| Temp. Limit | 65°C | 60°C |
| Temp. Limit | 100°C | 100°C |
| pH limits | 0-14 (stability) | 0-14 (stability) |
| pH limits | 05-10 (Operating) | 05-10 (Operating) |

**Table 2:** Initial COD values and Percentage reduction in COD with A500P and A109 (100 ml Sewage Passed)

| Sample No. | Initial COD | Final COD-A500P | Percentage COD reduction with A500P | Final COD-A109Q | Percentage COD reduction with A109 |
|---|---|---|---|---|---|
| S-1 | 180 | 90 | 50 | 83 | 54 |
| S-2 | 240 | 118 | 51 | 112 | 53 |
| S-3 | 260 | 126 | 52 | 120 | 54 |
| S-4 | 220 | 110 | 50 | 106 | 52 |
| S-5 | 200 | 100 | 50 | 95 | 53 |

**Table-3:** Initial COD values and Percentage reduction in COD with A500P and A109 (1000 ml Sewage Passed)

| Sample No. | Initial COD | Final COD-A500P | Percentage COD reduction with A500P | Final COD-A109Q | Percentage COD reduction with A109 |
|---|---|---|---|---|---|
| S-1 | 180 | 94 | 48 | 90 | 50 |
| S-2 | 240 | 123 | 49 | 118 | 51 |
| S-3 | 260 | 132 | 49 | 126 | 52 |
| S-4 | 220 | 113 | 49 | 109 | 50 |
| S-5 | 200 | 106 | 47 | 102 | 49 |

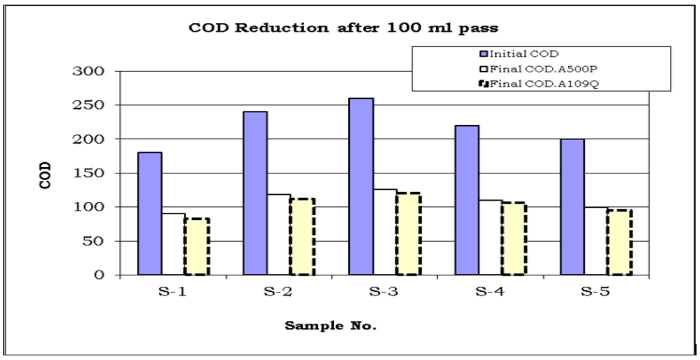


**Fig 1:** A comparative view of COD reduction after passing 100 mL of sewage through A500Q and A109 Columns

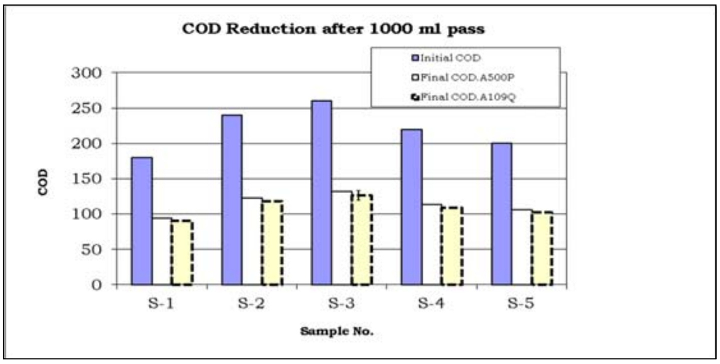


**Fig 2:** A comparative view of COD reduction after passing 1000 mL of sewage through A500Q and A109 Columns

## 5. Acknowledgements
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