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How to Improve LA Water's Countercurrent Demineralizer Systems

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Introduction

The current trend in the United States is for industries to install packed-bed countercurrent demineralizer systems. This is due to this method's many advantages over standard co-current systems, including the following:

- a shorter regeneration time due to the elimination of the backwash step
- no channeling through the resin bed during upflow service
- a substantial decrease in water usage during the regeneration step
- a 40-50% reduction in the amount of regenerants used during the regeneration cycle
- improved water quality

Along with Bayer AG who developed the WS packed-bed countercurrent technology in the early 1960's, LA Water showed great foresight when it installed countercurrent demineralizer systems in many of the phosphate plants built in the 1970's. Since then, various methods have been developed to enhance these systems. Plants that use LA Water's countercurrent demineralizers should take advantage of these ways to improve their systems. The techniques include the reduction of freeboard in the vessels, the installation of inert resins, and the use of special particle size-distributed ion exchange resins. Additionally, the maintenance of certain flow velocities during service start-up is encouraged as well as the adjustment of the regeneration schedules to optimize the use of acid and caustic and to conserve water. If these steps are taken, phosphate producers should experience both a reduction in their operating costs and an improvement in the quality of their demineralized water.

LA Water Demineralizers

The LA Water countercurrent demineralizers that were designed for use in the phosphate industry have a top and bottom hub and spoke distribution system. The service is up-flow and the regeneration is down-flow (see figures 1 through 4).

Techniques

A. Reduction of Freeboard

When the amount of freeboard is reduced in the vessels, the movement of the resin in the bed is minimized. This, in turn, maintains the top layer of resin as a final polishing layer. Ideally, when the resin is in its expanded form, there should only be 3 - 6 inches maximum of freeboard in each vessel.

B. Inert Resin

The use of inert resin during upflow service and downflow regeneration is recommended for several reasons. Because the inert resin is less dense than the water and the ion exchange resin in the vessels, it floats on top. This inhibits the ion exchange resin fines from clogging the upper outlet distributor. Another advantage of the inert resin is that it aids in the distribution of the regenerant by flowing through it during the regeneration cycle. Also, by bringing the layer of inert resin within range of the upper sight glass of the vessel, the freeboard measurement between the layers of inert resin and ion exchange resin can be determined (see figures 3 and 4).

C. Ion Exchange Resin

Another technique to enhance the performance of countercurrent demineralizers is the use of special particle size-distributed ion exchange resins in the system. In the past, ion exchange resins with a 16-50 mesh bead size have been recommended. However, if only uniformly-sized small beads are used, a pressure-drop problem might result. If only uniformly-sized large beads are used, there is no final polishing layer on the top of the resin bed during upflow service. Therefore, to achieve optimum performance, the ion exchange resins should have a 16-40 mesh bead size distribution. This eliminates the resin fines which could clog the distribution system. It also creates a final polishing layer of the smaller-sized beads on the top of the resin bed.

D. Service Start-Up

One start-up problem that some LA Water countercurrent demineralizer system users have experienced is that the resin bed fluidizes. This occurs when the start-up flow velocity is too slow and the resin expands as it is lifted in the vessel. As a result, the resin will suddenly begin to swirl at the top of the vessel instead of moving as a plug. In order to prevent the resin bed from fluidizing during start-up and to ensure that the upper 25% of the resin bed moves as a unit to the top of the vessel to act as a plug, a minimum velocity of 4 gpm/sq. ft. is recommended. After start-up, the flow of velocity can be brought down to 2 gpm/sq.ft. minimum.

E. Regenerant Usage

Another problem encountered by some LA Water countercurrent demineralizer users is the use of incorrect amounts of regenerants. As a rule, countercurrent units use fewer regenerants than co-current units. In general, an LA Water countercurrent demineralizer should use approximately 5-6 lbs/cuft of sulfuric acid to regenerate the strong acid cation resin and 2.5-3 lbs/cuft of caustic to regenerate the strong base type I anion resin. Actual amounts may vary according to the specific makeup of the water to be demineralized as well as the user's water quality requirements after the demineralizer process.

F. Water Conservation

Countercurrent demineralization technology is superior to co-current units in its conservation of water used during the regeneration cycle. It eliminates the backwash step entirely. This technological edge can be further enhanced by recirculating the water during the fast rinse step. In this way, only 3-4 bed volumes of water will be used for the regeneration cycle. It should be noted that if the rinsewater recirculation is started too early in the regeneration cycle, leftover caustic or acid could be recirculated through the bed. The optimal time to recirculate the water is only after the acid and caustic have been entirely displaced from the resin bed. This point can be determined by testing the conductivity.

G. Conductivity

If LA Water countercurrent demineralizers are not properly operated, high conductivity can be a persistent and serious problem. In general, if the previous suggestions for maximizing the capabilities of this system are followed, the rates of conductivity should be fewer than 2 micromhos/cm. However, this figure will vary according to the amount of regenerant used and the specific characteristics of the water to be demineralized.

Conclusion

If the preceding techniques are applied to

LA Water's countercurrent demineralizer systems, phosphate producers with this system could minimize the problems of fines clogging the distribution systems, pressure drop, high conductivity and resin movement in the packed-beds. These methods also reduce the amount of regenerant and water used during the regeneration cycle and create a final polishing layer of resin to improve the quality of the demineralized water produced. As a result of the careful application of these techniques, operating costs will be reduced and water quality will be enhanced.

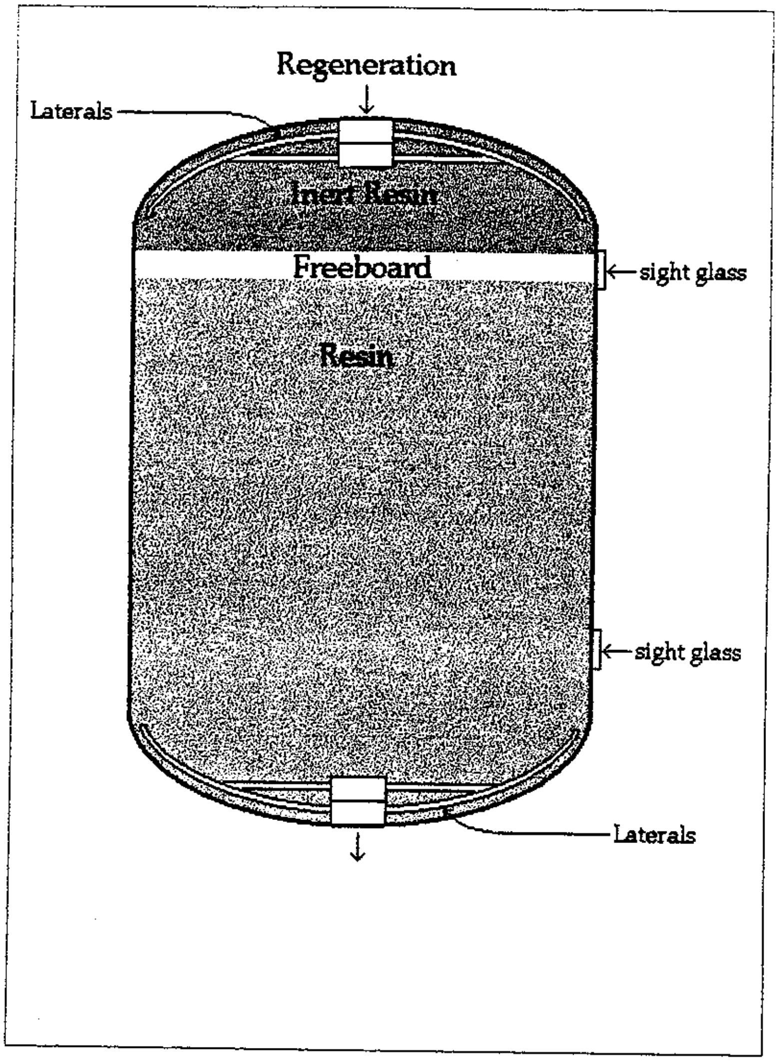

Figure 1

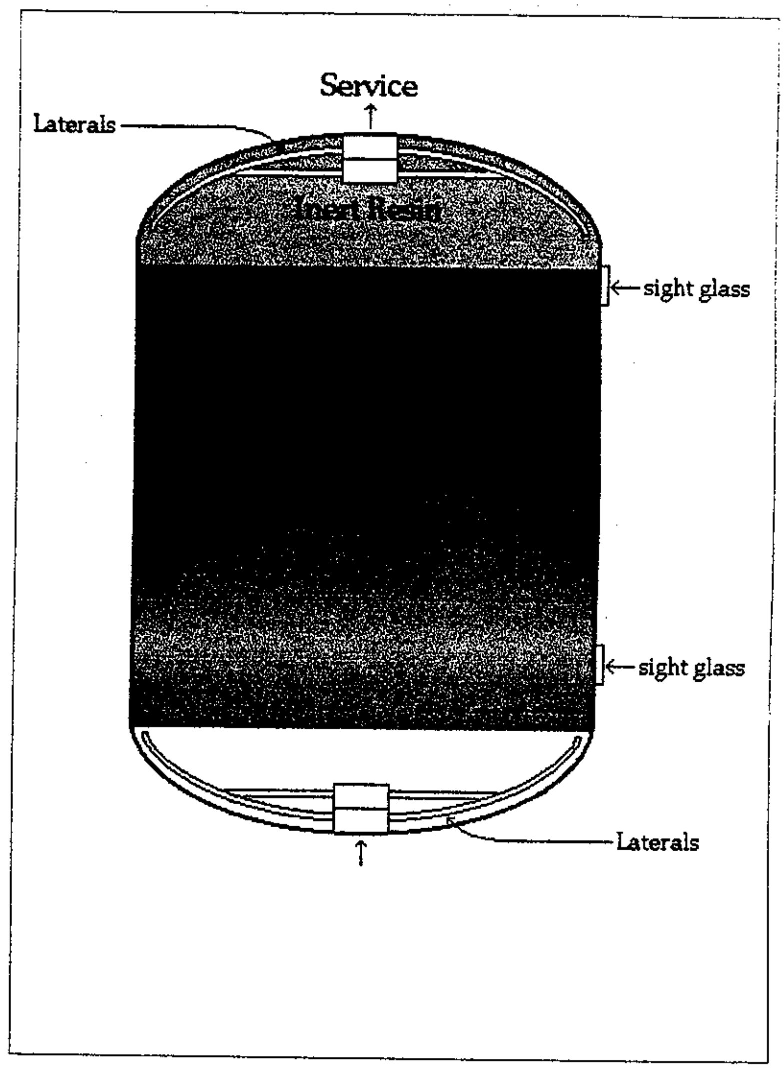

Figure 2

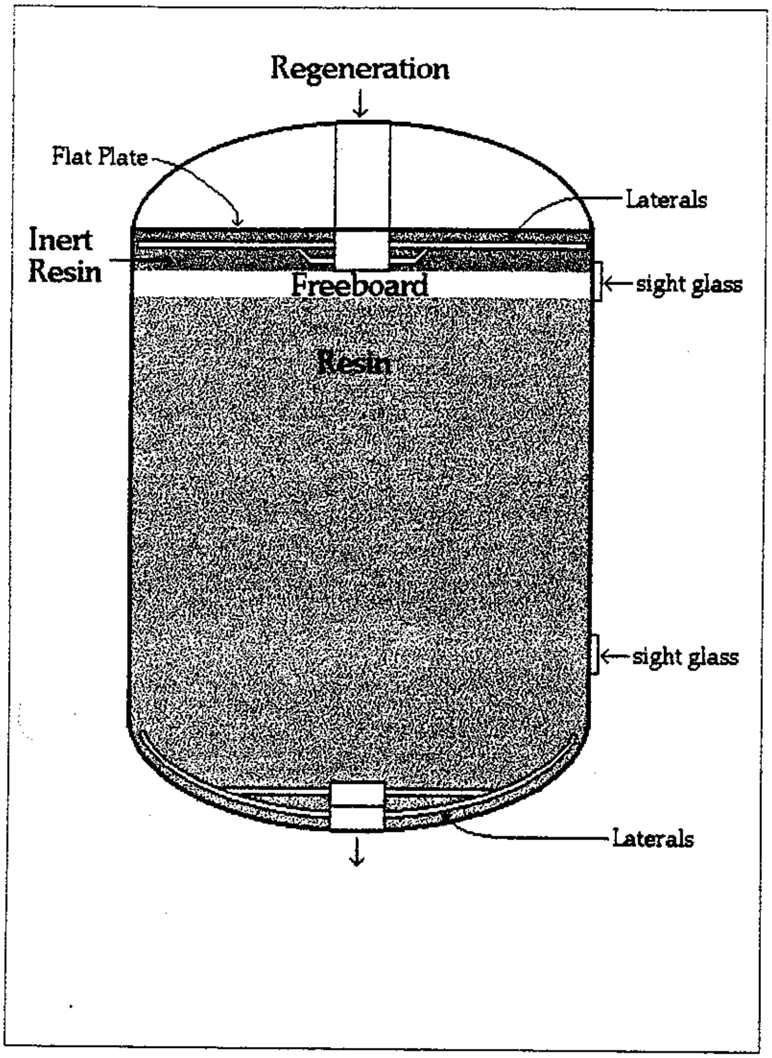

Figure 3

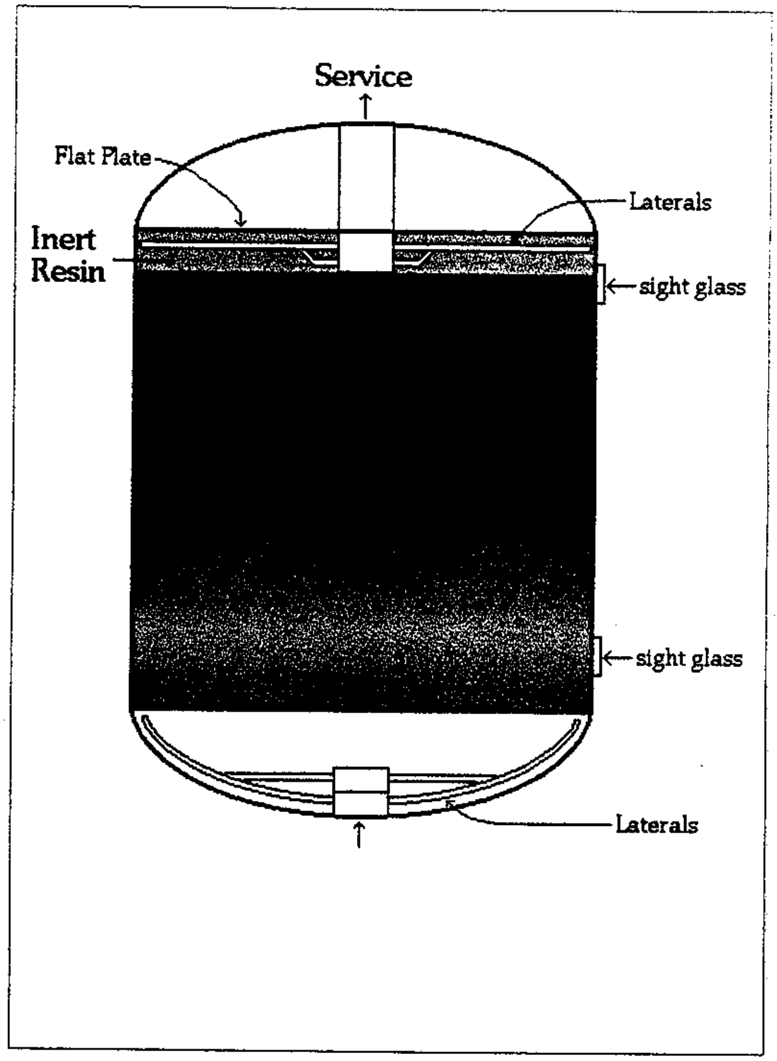

Figure 4