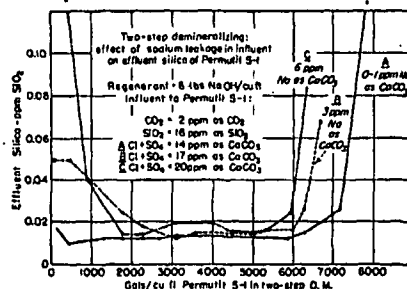
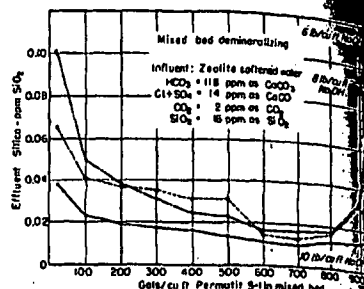


DEMINERALIZATION continued



TESTS on sodium leakage effect, on final results with 2-step treatment, point out need to hold the sodium to low level



REGENERANT dosages have to be strong, about 10 lb per cu ft, with a mixed-bed unit to get good, low silica effluent

Controlled Tests Point Up Difficulties in Ion Exchange

anion-exchange bed before you reach the flat part of the run as far as silica is concerned. In an actual plant you meet this requirement easily by lengthening the rinse to give a low-effluent silica during the rinse recycling. But certainly for best results with 2-bed operation, sodium in the water entering the anion-exchange unit must be held as low as possible.

Regenerant Cost. Further, we found it difficult to get a good, low-silica effluent of about 0.01 to 0.02 ppm of residual silica from a mixed-bed unit unless we kept regenerant dosages at about 10 lb of sodium hydroxide per cu ft of the resin, right, above. A dosage level down around 6 lb of NaOH per cu ft produced an effluent silica appreciably higher than 0.02 ppm. On the other hand, you can get the 0.01 to 0.02 ppm silica with a 6-lb NaOH regenerant dosage in a 2-bed demineralizer setup.

During the early runs, however, while the mixed bed was still young we could readily reduce effluent silica to 0.01 ppm of SiO_2 or less, employing NaOH at 180 F and in sufficient dosage. But as the bed got older it became increasingly difficult to maintain this silica quality. Even acid washings failed to restore the anion exchanger to its original silica-reducing ability.

Anion-Exchange Capacities. Our tests showed us that the anion-exchanger capacity in kg per cu ft is much lower in the mixed bed than in the 2-step operation. It averaged about 8 kg per cu ft of anion removal for Permutit S-1 in a mixed bed employing 10 lb of NaOH regenerant per cu ft of resin. Under the same conditions the Permutit

S-1 averaged 14 kg per cu ft capacity with a 2-step system. The anion load in the mixed bed ran higher because of the 118-ppm load from the bicarbonate alkalinity in the raw water.

Between the extra anion load and the reduced exchange capacity of the Permutit S-1 in the mixed-bed design an appreciably smaller amount of water could be treated by this system per run for the same volume of anion-exchange resin than with a 2-step unit. Fig. 5 illustrates the considerable differences with the two methods. The results do show, however, that you can get a demineralized water of a silica content between 0.01- to 0.02-ppm SiO_2 with both the mixed- and the 2-bed methods. But it takes carefully controlled conditions to assure these results.

Silica and Anion Ratio. Our test water carried a high ratio of silica to total anions, about 1 to 1. So we have begun tests to determine the effect of this ratio. Already indications point to the fact that the desirable, extremely low silica residual can be attained much easier for a 2-bed unit handling waters with a ratio of 1 part silica to 5 total anions. The higher this ratio gets, the more vigorous are the regenerant conditions you have to maintain to get the same results.

From this ratio experience it would seem the mixed-bed process, with the bicarbonates still in, would improve the silica to total anion ratio, and give better silica residuals. This has not proved out in practice, though. In fact, by close control of the sodium in the influent to the anion exchanger it appears easier to obtain silica removal to the 0.01-ppm level with the 2-bed than with

the mixed-bed demineralization process. Our tests, though, are still being tried out.

Iron Effect. Dissolved iron in the influent to the anion exchanger, for severe problems. It coats our anion-exchange resin and allows silica to climb in the effluent. While 2-step demineralizer the hydrogenation exchanger removes much of the dissolved iron in the raw water. Mixed-bed units suffer because the dissolved iron comes into ready contact with the anion-exchange resin. For the same reason other precipitants, a high water hardness, and measurable turbidity add to the mixed-bed operating problems.

To combat these problems, it is desirable to soften at least the regenerant and rinsing water meant for the anion-exchange portion of the mixed bed. Frequently a filter bed ahead of the mixed bed will prevent eventual clogging in the unit.

Economic Comparison. Table about the typical raw waters handled by demineralization processes. With most waters the mixed bed has advantages. Chart, at right on p. 74, portrays comparative costs except for erection, filter and softeners for a 50-gpm single-bed installation employing both mixed- and 2-bed operation.

When treating a low-solids water like New York City's Catskill supply the mixed-bed equipment runs much lower than for a 2-step design. Chemical costs with this raw water are not too great. But when you leave the low-solids waters (30-75 ppm) first cost and chemical costs combine to make the mixed-bed system relatively expensive.



MODERN HOSPITALS feature striking buildings, ample space. Yet they can be penalized if mechanical plant design is antiquated

Hospitals Need Mechanical Know-How

One-third the investment in a hospital is for heating and mechanical plant

Fuel costs alone vary from \$75 to \$256 per bed a year, depending on building design

Standby boiler capacity often goes in oversize, designed to meet extreme peaks, not base or average

NEERGAARD, Hospital Consultant
Neergaard, Agnew and Craig
New York and Toronto

IN THE AVERAGE HOSPITAL, cost of heating and mechanical plant represents upwards of one-third of the total investment. Its operation and maintenance bulk large in the yearly budget. Yet hospitals as an industry have never analyzed their precise needs. The answer is what you might expect—usually too much equipment for the job at hand. Here are some guides to good planning in this long-neglected field.

For years, architects, engineers and hospital building committees have felt the lack of simple, authoritative yardsticks to judge the requirements for power, heat, ventilation, air-conditioning, electrical equipment. Potentially the most valuable aid along these lines is the mechanical section of U.S. Public Health Service's publication, *Functional Basis of Hospital Planning*, put out by the Division of Hospital Facilities,

Washington, D.C. Let's see now what's been going on in the hospital field and try to draw some lessons.

Hospital bookkeeping usually groups power, light and heat in one account. But the bulk of the expenditures in this account are for heat. Fuel, alone, amounts to about 40% of the total. Tables I and II, on page 78, present a challenging comparison.

The five hospitals making up Table I spend from \$74 to \$188 a year per bed with 1950 fuel prices. Those making up Table II run all the way from \$186 to \$447 a year per bed. Major difference is the factor of insulation. Table I entries enjoy insulation in one-quarter to one-half the building area. The answer seems obvious. Yet its lesson is largely overlooked.

In 1947, 36 hospitals in the New York area with 6906 beds spent an aggregate