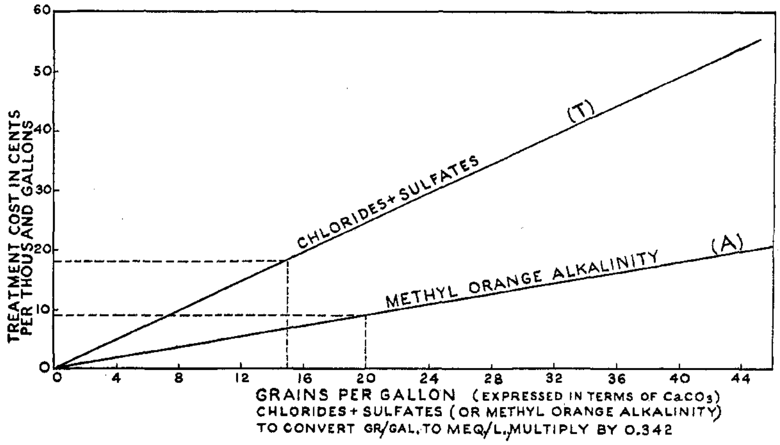

FIGURE 5. DEMINERALIZING REGENERATION COST

Costs can be read directly from these curves as shown by the following example: Raw water contains 20 grains methyl orange alkalinity per gallon and 15 grains theoretical mineral acidity. From 20 grains on abscissa (Figure 5), follow dotted line to curve *A* and then follow horizontally to ordinate, arriving at cost of 9 cents per 1000 gallons for alkalinity removal. From 15 grains on abscissa, follow dotted line to curve *T* and then follow horizontally to ordinate, arriving at cost of 18 cents per 1000 gallons for theoretical mineral acidity removal. Thus the total cost of demineralizing this water is $9 + 18 = 27$ cents per 1000 gallons, based on the chemical costs stated above.

Other Applications

Two-step demineralizing by ion exchange has also been applied to the removal of electrolytes from solutions of neutral organic materials. For some years numerous investigations have been carried on in this laboratory and in actual plants in various parts of the country in demineralizing sugar solutions at various stages of beet sugar manufacture and cane sugar refining. As is well known, these refining processes consist essentially of successive vacuum evaporations, followed by sugar crystallizations for the separation of the pure sugar from the mother liquor carrying the dissolved mineral impurities. The actual removal of a substantial portion of these dissolved impurities by two-step demineralizing, at certain steps in the process, makes it possible to crystallize a larger proportion of the sugar from these solutions, and actual experiments have also shown lower ash content in the sugar thus produced. Demineralizing experiments carried out in a beet sugar factory showed a reduction in ash content of the sugar sirup from 0.87–0.89 to 0.08–0.15 per cent in single-pass operation.

The value of this increased yield and improved quality must be balanced against the operating costs and fixed charges involved in the demineralizing process. Such costs also include required replacement of ion exchange material, which loses capacity at a somewhat greater rate when used with these more contaminated solutions. Experiments with the earlier ion exchange materials available in past years were successful in producing increased yields and improved quality of product. However, the economic balance of more and better yield *vs.* operating and depreciation costs was not very favorable. But with the better ion exchange materials now available and with improved methods of using these materials, recent experiments show a more favorable trend.

Several of the special operating methods described in the preceding sections are specially applicable to demineralizing solutions of high electrolyte content, such as impure sugar solutions containing high concentrations of electrolytes. Other experiments on purification of sugar solutions by ion exchange were reported recently (*11*).

Gelatin solutions may also be demineralized (*7*). Using single-pass operation, the ash content of one gelatin sample was reduced from 2.6 to 0.09 per cent. This process was carried out at 40° C., using a 5 per cent gelatin solution.

Demineralizing has also been suggested for the removal of salts from enzymes, glycerol solutions, and other solutions of organic materials. Further investigations in these and various other fields are in progress in this laboratory.

Acknowledgment

The cooperation of C. Calmon, P. C. Goetz, F. C. Nachod, R. Riley, and other associates in making this development a reality is hereby acknowledged.

Literature Cited

(1) Applebaum, S. B., *J. Am. Water Works Assoc.*, 30, 947–73 (1938).
(2) *Ibid.*, **32**, 583–92 (1940).
(3) Applebaum, S. B., and Riley, R., IND. ENG. CHEM., 30, 80–2 (1938).
(4) Arnold, C. B., Hanlon, R. T., and Mindheim, J., annual meeting, Am. Soc. Mech. Engrs., 1940.
(5) Briggs, R. R., *Combustion*, **12**, 27–31 (1941).
(6) Broderick, S. J., IND. ENG. CHEM., **33**, 1291–6 (1941).
(7) Holmes, E. L. (to Permutit Co.), U. S. Patent 2,240,116 (April 29, 1941).
(8) Myers, R. J., and Eastes, J. W., IND. ENG. CHEM., **33**, 1203–12 (1941).
(9) Myers, R. J., Eastes, J. W., and Myers, F. J., *Ibid.*, **33**, 697–706 (1941).
(10) Myers, R. J., Eastes, J. W., and Urquhart, D., *Ibid.*, **33**, 1270–5 (1941).
(11) Rawlings, F. N., and Shafor, R. W., *Facts About Sugar*, **37**, 26–8 (1942).
(12) Riley, R., *Paper Mill*, **61**, 20–6 (Sept. 24, 1938).
(13) Riley, R. (to Permutit Co.), U. S. Patent 2,267,841 (Dec. 30, 1941).
(14) Schwartz, M. C., Edwards, W. R., and Boudreaux, G., IND. ENG. CHEM., 32, 1462–6 (1940).
(15) Tiger, H. L., *J. Am. Water Works Assoc.*, **26**, 357–67 (1934); paper at meeting of Am. Water Works Assoc., 1933.
(16) Tiger, H. L., *Trans. Am. Soc. Mech. Engrs.*, 60, 315–25 (1938).
(17) *Ibid.*, 64, 49–63 (1942).
(18) Walton, H. F., *J. Franklin Inst.*, **232**, 305–37 (1941).
(19) Yoder, J. D., *Combustion*, **11**, 35–40 (1939).

PRESENTED before the Division of Water, Sewage, and Sanitation Chemistry at the 104th Meeting of the AMERICAN CHEMICAL SOCIETY, Buffalo, N. Y.

Specific Heat and Viscosity Nomographs for Calcium Chloride Brines—Correction

In the explanatory text accompanying these nomographs on page 1532 of the December, 1942, issue, the equation at the top of the second column should read as follows:

$$\log \mu = a + b[t - (10)^{0.154\,t\,-\,5.075}]$$

D. S. DAVIS

MICHIGAN ALKALI COMPANY
WYANDOTTE, MICH.