THE ELECTRODIALYTICAL PROCESS AS A METHOD FOR ACIDIFYING AND PURIFYING POLYSACCHARIDE SOLUTIONS

BY

V. R. HARDY

Department of Chemistry, University of Illinois, Urbana, Illinois

Research work having as its ultimate goal the preparation of a palatable syrup from the tuber of the Jerusalem artichoke (*Helianthus tuberosus*) has been in progress at the University of Illinois for several years. However, in the preparation of such a syrup two problems are of considerable importance: (1) the conversion of the polysaccharides contained in artichokes (inulin and various levulins) into simple sugars, and (2) the removal of undesirable non-sugar material which also occurs in the tuber.

Since certain difficulties are inherent in all of the conventional methods of solving these two problems, the possibility was investigated of accomplishing by one process both the acidification of the diffusion-battery extract obtained from artichokes, which acidification is necessary to effect conversion of the polysaccharides to simple sugars, and the removal of at least part of the non-sugar material in it. This process is based on the phenomenon of electrodialysis, which may be defined as the migration through diaphragms of ions under the influence of an electrical potential.

The extract containing, in addition to the polysaccharides, such salts as naturally occur in the artichoke tuber, was treated in an electrodialytic apparatus fitted with such diaphragms that an excess of the cations in the salts escaped. As a result an appreciable amount of water was ionized, the OH^- ions also migrating to the anode to equalize the positive charges carried to the cathode, and the H^+ ion concentration of the extract was increased. At the same time a considerable percentage of the colloidal material in the extract was discharged and coagulated. Therefore the procedure accomplished both the acidification of the extract and the removal of much of the inorganic salts and the organic collidal material in it.

A series of investigations was carried out in which the independent variables, viz. rate of flow of extract through the process, current density, concentration of solid material in the extracts, and the nature of the diaphragms, were varied and their effect on the dependent variables was noted, viz. $[H^+]$ produced in the extract, colloidal material coagulated, and cost of the process.

The results obtained may be summarized in a few generalizations:

(1) The final pH of the extract depends chiefly upon the per cent of cations or of total ash removed from it.

(2) Increasing either the rate of flow of the extract, or its concentration, or both, while other variables are held constant decreases the $[H^+]$ produced.

(3) Increasing the current density while other variables are held constant increases the $[H^+]$ obtained.

(4) The current density is directly proportional to the rate of flow of the solution if other variables are held constant.

(5) If the $[H^+]$ to be produced in the extract remains constant and the rate of flow of the extract is increased its concentration must be decreased or the current density increased, or both.

(6) About 40 per cent of colloidal material is coagulated during the production of an extract with pH of 1.2, that required for conversion of the polysaccharides under the conditions of our work.

(7) At 2 cents per kilowatt hour the cost of current to produce this pH is 0.04 to 0.1 cent per pound of finished syrup.

(8) With less permeable diaphragms in the apparatus the final pH is only slightly higher than with more permeable ones.