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The Use of Ion Exchange Resin
As an Aid in Analytical Chemistry

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With the advent of advances in instrumentation and techniques down
to all levels of teaching, there is a tendency to overlook some of the
simpler analytical methods although these may be just as good and evenfaster to perform than the more complicated standard ones. One case in
point is the determination of metal concentrations, like Li⁺, Ca²⁺ or Mg³⁺.
The standard techniques for these ions appear to be EDTA titrations with
various more or less exotic indicators under conditions where the solutions
must be kept buffered at some constant pH. The experience of this author
is that students invariably encounter difficulty in determining the proper
end-point.

The alternative and simpler method utilizes an inexpensive, strong
acid ion exchange resin packed in column form. One merely puts a measured
aliquot of the solution to be analyzed into the top of the column and
washes the column with distilled water. The positive ions exchange with
the protons on the resin and the emerging solution is simply that of the
original anions, and hydrogen ions instead of the positively charged
cations put into the column. This acid can now easily be titrated with standardized base and some acid-base indicator—the later depending on the anion present. Since the total equivalents of charge put into the top of the column is exactly equal to the total equivalents of hydrogen ions which emerge, the titration yields the total equivalents of charge originally present from which one can deduce the metal concentration.

The method lends itself well in being used together with other more or less standard techniques. For instance, if there is a solution containing two positively charged cations, A and B, and the concentration of one of these, say A, can be determined by either spectroscopy or direct titration, the concentration of B can be determined as follows: the total charge concentration is determined by the ion exchange technique; then the contribution to the total charge by the ion A is subtracted leaving the contribution from the ion B. This is then converted to concentration in moles per liter depending on the charge on B. An example of this in this author's experiments has been the determination of the hydrogen ion and chromic ion concentrations, the latter being found by spectroscopy and the former by the difference as just explained.

Ion exchange resin can also be used in determining the hydration state of solid compounds. Often the exact composition of a salt crystallized from water must be known as far as the number of waters present per molecule of salt. Assuming no other material is present except cation, anion, and water, the precise amount of water present can be determined by weighing some convenient amount of the solid compound, dissolving this sample completely in water and adding to a column of ion exchange resin. Distilled water is again used to wash off all the displaced free acid which can be
titrated. The equivalents of charge titrated can then be converted to moles of salt put into the column, which is then converted to grams of the salt. The difference between this and the original weighing corresponds to the total amount of water present.

No special apparatus is needed for these sorts of determinations. It should also be noted that the possible hydrolysis of a metal attached to the column can be ignored since the total charges from the metal species remain the same. The chemical requirement is that the resultant acid be easily titrated; that is, that the anion not be the salt of an extraordinarily weak acid.

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