this assumption that the vapor follows the gas laws be not allowable, the work can be calculated from the characteristic equation of the vapor. The heat available for evaporation will be not only the heat of condensation of the saturated steam, but also the heat produced by isothermal compression of the vapor between the pressure limits indicated. This heat supply will in general be nearly though not exactly equal to the heat of vaporization of the solution in question. The difference must be supplied or disposed of as the case may be.

It is evident from the above that the thing required for the separation of solvent from a solution is not primarily heat, but energy in the form of work. It is possible to furnish this energy through the mechanism of a drop in temperature, so that heat falls from a higher temperature to a lower one. This furnishes the work through a mechanism which is essentially equivalent to a Carnot heat engine. This is the explanation of the necessity of a drop in temperature between succeeding effects of a multiple-effect evaporating system concentrating solutions, even though that system be ideal in all respects.

The possibility of operating a commercial evaporating unit upon the principles outlined above was first suggested to the writer by P. H. Sadtler, of the Swenson Evaporating Company, in 1910, and we understand that such a unit is now in actual industrial operation on an experimental scale in this country.

While it is theoretically possible thus to calculate the minimum consumption of both heat and energy for the removal of solvent from any solution, the determination of the necessary data and agreement as to the necessary conditions of operation would be so difficult that the method is inadvisable, at present, at least, for reporting commercial tests.

The writer therefore recommends that the heat consumption of all types of apparatus for the evaporation of volatile substances be reported as B. t. u. per pound of substance evaporated and that this method of reporting experimental results be made mandatory by the American Chemical Society upon its members.

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IMMEDIATE AND CONTINUED LIME REQUIREMENT vs. ACTIVE AND LATENT SOIL ACIDITY

Editor of the Journal of Industrial and Engineering Chemistry:

In THIS JOURNAL, 8 (1916), 341, there appeared an article entitled "A New Apparatus for the Determination of Soil Carbonates and New Methods for the Determination of Soil Acidity," by Prof. E. Truog, of the University of Wisconsin. This article contained reference to an article entitled "A Method for the Determination of the Immediate Lime Requirements of Soils," by the undersigned, which appeared in THIS JOURNAL, 7 (1915), 864. From comment in the same paragraph containing reference to the work of the undersigned one might easily infer that no previous lime requirement method had taken in consideration this difference between *immediate* and *continued* lime requirement or "soil acidity." To quote Prof. Truog, "All of the methods just described have been of value in that the results indicate in a comparative way the degree of acidity. None of them, however, indicate the absolute amount of acidity as has sometimes been assumed. Lately, Hutchinson and MacLennan and also MacIntire have described methods in which a solution of CaCO_3 in carbonated water is used." Again to quote from the preface to the description of the method devised by the undersigned and cited above—"The studies further led to the conclusion that there is a considerable difference between a soil's immediate ability to decompose CaCO_3 and its propensity to continue the decomposition when soil and an excess of CaCO_3 continue in moist contact. That this observation is to be found in practice is shown by the analysis of the lime-treated plats of the Pennsylvania Station. Thirty-five per cent of the lime accumulated on these plats after 32 years of treatment is to be found as silicates. In offering the method, the differentiation is, therefore, made between *immediate* and *continuous* lime requirements of soils."

It is thus plain that this difference was recognized and emphasized by italicized type in the method of the writer for lime requirement, which was quoted by Prof. Truog. However, Prof. Truog's article did not state that this prior differentiation in lime absorption by soils had been made. Therefore, one might readily conclude that no mention of the distinction had appeared in print, prior to the appearance of the findings and conclusions of Prof. Truog. Instead of the terms *immediate* and *continued* lime requirements as advanced by the writer, Prof. Truog used the terms *active* and *latent* acidity. This distinction of terms is in harmony with the attributed differences as to the causes of the lime absorption; the writer attributing the decomposition primarily to the absorption of calcium by acid-silicates, while Prof. Truog states in his conclusions: IV—"Data are given indicating as follows: Soil acidity is due to true acids and not selective ion adsorption by colloids." After careful and repeated readings of the article by Prof. Truog, the undersigned has failed to find these data, above mentioned.

In *Bulletin 107* of the Tennessee Station, 1914, the writer, together with Messrs. Willis and Hardy, offered data to demonstrate the continued evolution of CO_2 from excessive treatment of CaCO_3 upon soils (where questions of biological influences and organic matter were eliminated) for a period of over two years, while the longest period of observation given in the article by Prof. Truog was 17 hrs. This phenomenon also continued in lesser degree after igniting a soil at white heat for a period of 16 hrs., even where the soils heated contained a large excess of CaCO_3 . Such an acid as would resist this treatment and still remain, even as "latent acidity," would indeed be an unusual "true acid." The same might be said of acid silicates and colloids in general. Apparently, however, SiO_2 and TiO_2 are possessed of such unusual properties that upon moistening after ignition they will continue to evolve CO_2 from CaCO_3 , but more particularly from MgCO_3 .

After describing his procedure and giving his method for quantitatively distinguishing between the two forms of lime requirement or soil acidity, Prof. Truog stated in the concluding paragraph of his article:

"The enormous supply of latent acid substances in many soils of the humid region as indicated by these methods is of the greatest importance in preventing excessive losses of bases by leaching. It also offers a further explanation why MacIntire, Hardy and Willis were able to secure large decompositions of MgCO_3 , when this material was left in contact with soil that supposedly had been completely neutralized."

One might infer from this statement that Prof. Truog was doubtful whether the full absorption coefficient of the particular soils had really been fully met by the materials applied, *i. e.*, that the "active acidity" had been neutralized while the "latent acidity" had not. If such an explanation alone were capable of accounting for the heavy decomposition of precipitated MgCO_3 there would needs be attributed to the "latent acidity" a wonderful power of selective absorption of bases; for although the MgCO_3 treatment equivalent to 16 tons of ground limestone per acre 6 in. had entirely decomposed at the end of 8 weeks, there remained at the end of 9 months approximately 22,000 lbs. of CaCO_3 where this equivalent treatment was given as ground limestone. Furthermore, at the end of 8 weeks approximately 20,000 lbs. of CaCO_3 remained where equivalent treatment of precipitated CaCO_3 had been applied.

Many data reported in *Bulletin 107* of the Tennessee Station and many additional subsequent findings have seemed to justify the conclusion that the extensive decomposition of MgCO_3 must be attributed to absorption by acid silicates and reaction with hydrated SiO_2 and TiO_2 .

ITHACA, NEW YORK
April 13, 1916

W. H. MACINTIRE