REDOX POTENTIALS OF DESERT SOILS UNDER VARYING CONDITIONS OF STERILIZATION, AERATION, AND PUDDLING\textsuperscript{1}

Abstract

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This investigation is part of a general project to study the effect of puddling on soil fertility. It deals with the rate of organic matter decomposition in the presence and absence of microorganisms, under various gaseous atmospheres, and in soils under normal and puddled conditions. In the preliminary experiments here reported, organic compounds of known composition, and including representative carbohydrates, proteins, and organic acids, were incorporated with sub-samples of Palos Verdes sandy loam, incubated at optimum moisture content and constant temperature, and the redox potentials measured over a period of time.

It was found that these compounds gave redox potential-time curves such that they could be grouped into classes according to their dominant chemical nature. Thus the samples treated with starch, gum arabic, and casein constituted one group, those treated with succinic and benzoic acids another; the untreated and cellulose-treated samples and probably also the urea-treated samples a third; and the cystine-treated sample a group by itself.

In all instances, the puddled samples developed a lower potential than those left in the unpuddled state. Pronounced and sustained potential lowering, however, occurred in the puddled starch, gum arabic, casein, and cystine treated samples only. When the soil samples containing the incorporated organic compounds were sterilized, the potentials remained the same as that of the check whether puddled or unpuddled. It is evident, therefore, that changes which occurred in the treated soil samples were the result of microbial activity.

Evidence was also obtained which shows that the nature of the gaseous atmosphere over the solution at the time of measurement markedly affects the potential. When nitrogen was bubbled through the soil suspension, the potential invariably decreased, whether the soil had been sterilized or not and whether puddled or unpuddled. After a sharp decrease within the 2 to 4 hours, the potential became constant at a value several hundred millivolts below that obtained under air. When aerated with oxygen, on the other hand, the potential either remained constant, or increased slightly. If the system was poised, as for example with quinhydrone, the potentials obtained under pure nitrogen, pure oxygen, or air were identical.

These experiments have demonstrated conclusively that the measurement of redox potentials, or of storing soil samples under nitrogen before measurement of the redox potential, invariably leads to erroneous results. Furthermore, there exists a "suspensions-effekt" in redox measurements similar to that observed in pH determinations, making it necessary that the soil be kept continuously in suspension during the course of measurement. Vigorous mechanical stirring in air was found to be most conducive to reproducibility in the redox potential measurements.

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