

EFFECT OF HUMIC SUBSTANCES ON THE RATE OF EXCHANGEABLE
Ca and K IONS DESORPTION FROM MONTMORILLONITE

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Synopsis. The rate of exchangeable potassium and calcium desorption from humus containing montmorillonite was investigated by means of electrodialysis. Humic substances were adsorbed on montmorillonite during humification of oak leaves.

INTRODUCTION

The processes of exchangeable ions uptake are of primary interest in natural soils. These processes are influenced by presence of organic-mineral complexes. The difficulties of investigation of the properties of soil organo-mineral compounds lay in the lack of the standard mild methods of their extraction as well as the lack of methods of organic matter removal non-destructive for soil mineral matrix. In the authors opinion the most correct way to study the processes of exchangeable ions desorption in connections with the presence of organo-mineral compounds is to investigate the changes of mineral phase properties before and after its contact with plant residues directly during the humification process.

The purpose of the present work was to investigate the influence of the organic compounds adsorbed on the montmorillonite during the humification of oak leaves on the exchangeable K and Ca ions desorption rate.

MATERIALS AND METHODS

Montmorillonite samples were Ca and K saturated by standard procedure (3x equilibration with 1N chlorides solutions and washing the excess salt to the negative reaction with silver nitrate). Homoionic forms of montmorillonite were then contacted with the excess of oak leaves during 60 days period at 25°C. The humus containing montmorillonite was then taken out by wet sieving and centrifuging following by washing with distilled water. The final sediment have been dried at 40°C. Portions of the final sediments have been additionally Ca and K saturated in the manner described above. The samples for the experiments were selected as follows:

M(Ca), M(K) - homoionic montmorillonites,

M(Ca)H, M(K)H - M(Ca), M(K) after contact with oak leaves,

MH(Ca), MH(K) - M(Ca)H, M(K)H after saturation with the appropriate ions.

The percentage organic matter (Tiurin) for the samples was:

M(Ca)H - 1.75, M(K)H - 1.34, MH(Ca) - 1.71, MH(K) - 1.26.

The extractions of the exchangeable ions from all investigated samples have been performed by means of electrodialysis with three chamber apparatus supplied with network platinum electrodes and cellophane membranes. The distance between electrodes was 5.5 cm and electric potential of 250 V was applied. The samples were suspended in 0.3 N boric acid in order to eliminate electrophoresis phenomena causing blocking of membrane pores [1,4]. The concentrations of Ca or K ions in cathode chamber solution were measured every 10 min - Ca by atomic adsorption spectrophotometry and K by flame photometry. The results were described using Aleshin equation [2]:

$$Q = Q_m \frac{t}{a_0 + t},$$

where Q [cmoln⁻¹ kg⁻¹] is the quantity of ions electrodialysed after time t [h], Q_m is the total quantity of electrodialysable ions and a_0 [h] is the halftime of electrodialyse. The detailed description of calculations is given elsewhere [4].

RESULTS AND DISCUSSION

Values of Q_m and a_0 for the investigated samples are presented in Table 1.

It is seen that the content of exchangeable cations (assuming Q_m equals exch.) differ among the investigated samples. Exchangeable Ca increases in the direction: M(Ca) < M(Ca)H < MH(Ca) what can be caused by rather high content of Ca in oak leaves. Ca ions evolved during the leaves decomposition processes may be adsorbed

on organo-mineral surfaces. Exchangeable K in M(K)H sample is lower than in M(K) what can be explained by the exchange with Ca coming from decomposed leaves and also by losses of K with humic compounds during washing procedure.

Table 1

Values of the halftimes of electrodialysis (a_0 [h]) and the total electrodialysable cations (Q_m [cmoln⁻¹ kg⁻¹]) for the samples studied

*	M(Ca)	M(Ca)H	MH(Ca)	M(K)	M(K)H	MH(K)
Q_m	58.0	75.0	78.0	51.0	40.4	65.0
a_0	0.9	0.6	0.8	0.2	0.2	0.3

*Samples abbreviations see the text.

Values of the halftimes of electrodialysis for Ca forms of investigated samples are in the range of 0.6 to 0.9 h and for K forms 0.2 to 0.3 h. It can be stated that in every case K desorption rate is much higher than Ca so potassium ions are less strongly bonded to the investigated surfaces.

Considering a_0 values for homoionic series of the investigated samples one can find that humic compounds adsorption on montmorillonite lead to the diminishing of Ca ions bonding strength while in the case of K ions the effect is opposite. The latter effect may be explained by possible blocking of interlayer spacings by K-form of humic compounds.

CONCLUSIONS

Humic compounds adsorption on montmorillonite decrease Ca ions bonding strength while for K ions the effect is opposite.

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WPLYW SUBSTANCJI HUMICZNEJ NA SZYBKOSĆ DESORPCJI WYMIENNYCH KATIONÓW
Ca I K Z MONTMORYLONITU

S t r e s z c z e n i e

Za pomocą elektrodializy przeprowadzono badania szybkości ekstrakcji jonów Ca i K z montmorylonitu przed i po jego nasyceniu związkami humusowymi pochodzącymi z rozkładu liści dębu. Stwierdzono, iż obecność związków humusowych powoduje zwiększenie szybkości ekstrakcji jonów Ca, a zmniejszenie jonów potasowych.

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ВЛИЯНИЕ ГУМУСОВОГО ВЕЩЕСТВА НА СКОРОСТЬ ДЕСОРБЦИИ ОБМЕННОГО
Са И К ИЗ МОНТМОРИЛЛОНИТА

Р е з ю м е

С помощью электродиализа были проведены исследования скорости экстракции ионов Са и К из монтмориллонита перед и после насыщения его гумусовыми соединениями, возникшими вследствие разложения листьев дуба. Установлено, что наличие гумусовых соединений вызывает рост скорости экстракции для ионов Са, а снижение для ионов калия.