Assessment of Zn – soil colloid bonds as an index of availability

Ocena połączeń Zn – koloidy glebowe jako wskaźnik dostępności

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The study was undertaken in order to evaluate the Zn – soil colloid bonds as an index of availability. Thirty three (33) soil samples of varied physical and chemical properties have been used. Special care was given to the content of Zn, silt and Clay as well as organic matter.

Basic soil properties were first determined: soil particles, pH (in 0.01 mole $CaCl_2$ dm^{-3}), cation exchange capacity (CEC in 1 mole CH_3COOH dm^{-3}, pH 7.0) and organic carbon content (C_{org}). Then, further investigations were performed by using elaborated tests:

- Test I: influence of different temperatures (25, 35, 45°C) and oxidation by using H_2O_2 for disintegrating organically bound Zn.
- Test II: effect of alkalizing factors (reaction with NaOH: pH 8.5 and 10.0) on the release of Zn from soil colloids.

For the purpose of this study, a retardation factor (R_{fac}) was calculated for assessing the potential retention/migration process. The stability of Zn bonds with mineral soil colloids was evaluated by the Gibbs free energy change (ΔG^o). The highest the ΔG^o values the strongest the Zn was retained by soils, i.e., the less its release.

On the basis of the clay content, most of investigated soils should be classified as slightly clayey. More than 61% of soils exhibited a soil pH high above 6.0. The content of organic carbon ($C_{org.}$) fluctuated in a wide range, within 0.27 and 3.71%. Data have shown, that the stability of the bonds between Zn and soil colloids rose with increasing the temperature (Test I with 30% H_2O_2). The retardation factor (R_{fac}) varied significantly according to the testing method. The same applied also to the Gibbs free energy of change (ΔG^o) as listed in the table below. The lowest the ΔG^o values, the strongest the bonds, then the much more stable the Zn – soil colloid system.

Table. Changes in the Gibbs free energy of change (ΔG^o) for Zn in the soils

Statistical description (n = 33)	Test I (30% H_2O_2)			Test II (NaOH)	
	25°C	35°C	45°C	8.5	10.0
	$\Delta G°$ ($kJ \cdot mol^{-1}$)				
Min.	-12.64	-27.83	-26.75	-23.15	-20.65
Max.	-3.33	-2.88	-0.89	-0.90	-2.02
Mean	**-6.91**	**-15.57**	**-16.61**	**-13.23**	**-13.13**
SD*	±1.89	±7.63	±7.71	±6.40	±5.72

* Standard deviation