Abstract

Environmental Aspects of the Use of Iron and Steel Slags as Agricultural Lime

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Liming of soils in humid climatic regions under agricultural and forest use is an essential measure to obtain and to preserve an optimum soil reaction and soil structure. It counteracts an acidification of soils caused by lime neutralisation and leaching and consequently encourages soil fertility. For this purpose carbonate limestone as well as silicate liming materials are in common use. This paper presents different properties of silicate liming materials from iron and steel slags and their effect on soils and plants under environmental aspects, based on results from pot and field experiments.

Liming reduces the mobility of heavy metals and phytotoxic elements as aluminium in acid soils. On highly acid soils as they are common in forests of middle and north Europe the use of blast furnace or converter slags as silicate liming materials, supplying the soils with alkaline earth metals and soluble silica, prevents irreversible soil degradation caused by clay mineral decomposition and silica dissolution.

Increasing the calcium and silicon contents in the soil solution by use of silicate limes leads to higher soil aggregate stability, improves soil structure, and reduces soil degradation by erosion. Consequently higher uptake of silicon by plants increases their resistance against different plant diseases and minimises the use of pesticides. The solubility of silicon from blast furnace and LD-slags is significantly higher than that of silicon rich rock powders.

Converter slags may contain higher concentrations of chromium depending on the qualities of iron ores and scraps in the steel plants. Chromium in LD-slags occurs only in trivalent form. While Cr (III) is non-toxic and essential for human health the hexavalent chromium (Cr (VI)) is toxic, principally as an oxidising agent in living cells. It is reduced rapidly to Cr (III) in humus soils with neutral or acidic soil reaction. Long-term liming with converter slags may accumulate chromium in soils because of no leaching as an effect of strong immobilisation of Cr by organic matter and little Cr uptake by plants. Investigations of long-term field trials up to more than fifty years with annual application of iron and steel slags show that yields of crops on slag treatments were still highest compared to treatments with treatments of non chromium containing liming materials without any reduction of soil fertility.

Biographical Details

Dr Martin Rex

1953 Born in Theuernitz/East Prussia, now Poland.

1972-1976 Study of agronomy at the University of Gießen, West Germany.

1977-1982 Research works about interactions between soil properties, plant nutrition and root development in soils at the Institute of Soil Science and Soil Conservation, University of Gießen, and at the Agricultural Research Station Büntehof (Kali und Salz AG) in Hannover.

Since 1983 at the agricultural Research Station Kamperhof in Mülheim an der Ruhr of Thomasdünger GmbH working about fertilisers and liming materials produced from iron and steel slags and their use in agriculture and forestry under aspects of yield physiology, soil conservation and environmental protection. Since 1990 director.

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