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Environmental Pollution 153 (2008) 1–2
ENVIRONMENTAL POLLUTION
www.elsevier.com/locate/envpol

Guest editorial

# Chelating agents and the environment

The behavior of chelating agents in the environment has received considerable attention for more than 50 years now. EDTA (ethylenediaminetetraacetic acid), for example, occurs at higher concentrations in European surface waters than any other identified anthropogenic organic compound (Reemtsma et al., 2006). Chelating agents have the potential to perturb the natural speciation of metals (Nowack, 2002) and to influence metal bioavailability (Sunda and Guillard, 1976). The largest concern, however, is that many chelating agents (e.g. EDTA and most phosphonates) are only slowly biodegradable and are therefore rather persistent in the environment (Bucheli-Witschel and Egli, 2001).

The perception of the environmental effects of chelating agents is strongly influenced by the abundance of research on EDTA (Nowack and VanBriesen, 2005), and its low biodegradability has shaped the discussion about the problems of chelating agents (Williams, 1998). The focus of the research on chelating agents has shifted significantly over the years (Fig. 1). The research on anthropogenic chelating agents in the environment started in 1950 with a publication on the effect of EDTA on algal growth (Hutner et al., 1950). In 1951 the first description of the use of Fe(III)EDTA as iron fertilizer for chlorotic plants was published (Jacobson, 1951). This observation sparked a lot of research activity on the effect of chelating agents on metal solubility in soils and their influence on metal uptake by plants (Wallace, 1962, 1983). Until the beginning of the 1970s most research about chelating agents in the environment dealt with soil and plant related topics. Research on natural waters, lakes and rivers started in the 1960s but did not became important until the 1970s. The 1970s also saw an increase in the research devoted to biodegradation, analytics, and wastewater. The research activity remained quite low until the beginning of the 1980s with 10–20 publications per year. The next 20 years then saw a significant increase, and in 2006 more than 80 papers were published. Since the middle of the 1990s the research on chelating agents in the environment has increased dramatically. This increase has been mainly due to the proposed use of chelating agents for soil remediation, both for extraction of metals and for chelant-enhanced phytoremediation (Peters, 1999; Nowack et al., 2006).

The research on the interactions of chelating agents with the environment has always been two-sided: on the one hand the research started with an application of chelating agents in the environment, in particular their use as iron-fertilizers. Also the recent increase in publications about chelating agents in the environment is caused to a large extent by their proposed use for soil remediation and not by studies on chelating agents as pollutants. Soil remediation research has remained the most active type to date, accounting in 2006 for 40% of all publications related to chelating agents in the environment.

This volume of *Environmental Pollution* contains a selection of papers presented at the conference "Chelating agents between science, industry, authorities and users", held from March 11–16, 2007, on Monte Verità, Ascona, Switzerland. These papers exemplify the current research agenda on chelating agents with four out of the seven papers dealing with their use in soil remediation. Lestan et al. review the current knowledge on use of chelating agents for soil washing and phytoremediation. The papers by Hong, Popov and Israr present data on different remediation techniques: soil washing, electrokinetic remediation, and phytoremediation. The paper by Nancharaiah et al. describes the biodegradation of a chelating agent and the paper by Kent et al. the behavior of EDTA in

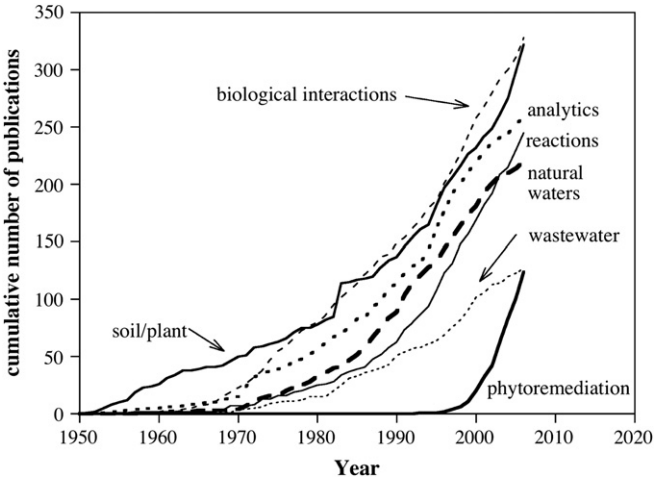


Fig. 1. Cumulative number of publications about the use and the effects of chelating agents in the environment, beginning with the first publication in 1950 until end of 2006. *Soil/plant*: effect on metal uptake by plants, use as fertilizers, solubility of metals in soils, soil washing; *biological interactions*: biodegradation, bioavailability of metals, ecotoxicology; *analytics*: determination of chelating agents in natural samples; *reactions*: adsorption, photodegradation, chemodegradation, complexation; *natural waters*: behavior in rivers, lakes, drinking water, groundwater, remobilization of metals from sediments; *wastewater*: behavior during wastewater treatment, removal from wastewater; *phytoremediation*: use in chelant-enhanced phytoremediation.

0269-7491/$ - see front matter 
doi:10.1016/j.envpol.2007.12.016

groundwater, two topics that have been intensively studied in the past. The paper by Pessagno et al. deals with glyphosate, a phosphonate-containing chelating agent. While glyphosate is best known as active ingredient in the world's most widely used herbicide Roundup (Franz et al., 1997), it is also a potent chelating agent. The phosphonic acids, to which glyphosate belongs, have received only marginal attention so far despite their widespread use in many consumer and technical products (Nowack, 2003).

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10 December 2007