7-8 Towards Treatment of Toxic Materials and Utilization of Radioactive Wastes

— A Novel Method for Non-Toxic Treatment of Cr(Ⅵ) Wastes by Using Ionizing Radiation —

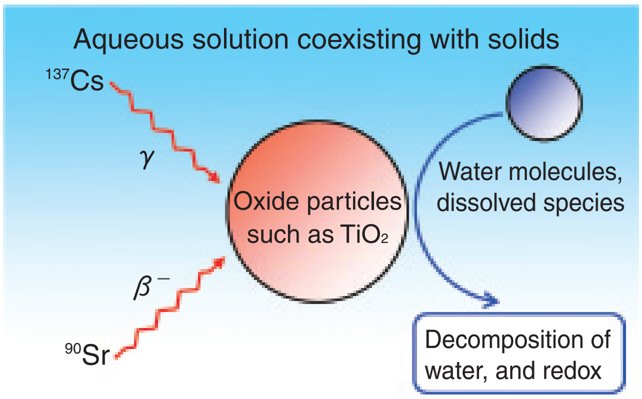

Fig.7-19 Promotion of reaction in aqueous solution by solids under irradiation

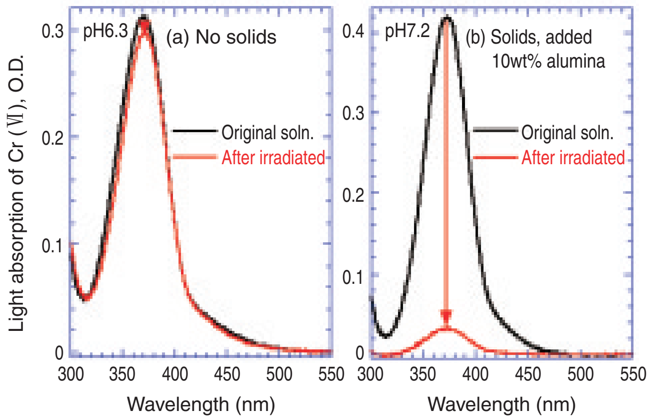

Fig.7-20 Absorption spectra of Cr(Ⅵ) ion in aqueous solution

In aqueous solution at pH conditions like liquid waste and environmental water, Cr(Ⅵ) is not reduced by irradiating radiations (a). When a small amount of solids are added to the solution, Cr(Ⅵ) is remarkably reduced (b).

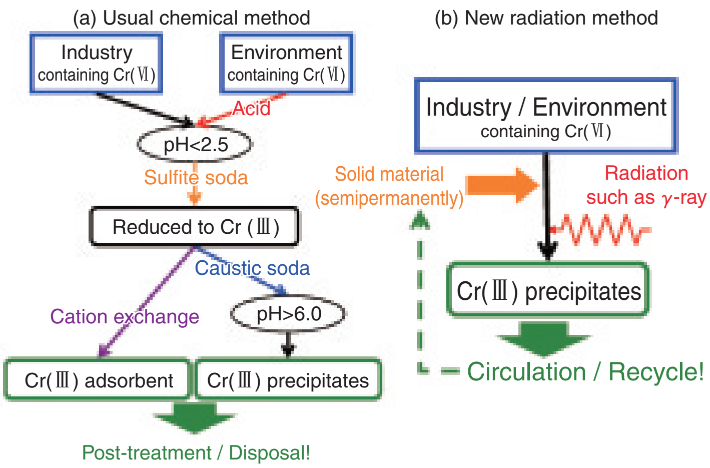

Fig.7-21 Schematic diagram of non-toxic treatment

The usual method (a) needs a large amount of dangerous reductants, acids and alkalis, and thus has many issues such as high cost and post-treatment. The new method (b) is simple and environmentally friendly because those chemicals are not needed.

When a medium (liquid and gas) containing solids such as oxide particles is irradiated by radiations, chemical reactions of ions or molecules in the medium are sometimes promoted without the consumption of solids (Fig.7-19). We have applied this promotive effect to practical systems, and developed a novel method for non-toxic treatment of chromium(Ⅵ), Cr(Ⅵ). Cr(Ⅵ) is so harmful to cause cancer, but is useful as industry for surface finishing of metal, production of colorants, etc. Its discharge to the environment must therefore be limited. To develop this method, we investigated how to treat Cr(Ⅵ) using radiation instead of a large amount of chemicals, though in aqueous solution like industrial liquid wastes and environmental water, Cr(Ⅵ) is hardly reduced by radiation.

Compared with the usual method, our novel one has several advantages: (1) Cr(Ⅵ) concentration after treatment is reduced under the emissions standard, without using a large amount of the chemicals (Fig.7-20), (2) the treated chrome materials can be recycled usefully into fire-retardant bricks, catalysts etc. without discharge into the environment, and (3) easy operation and easy maintenance (Fig.7-21).

In order to further make the novel method fit for practical use, we are developing treatment technology of industrial wastes such as electroplating waste liquids and polluted soils, jointly with a local factory and with a corporation. Since the promotive effect is also effective for treatment of other heavy metals and organic compounds which are social issues, and for generation of hydrogen gas as a clean energy, we are simultaneously conducting R&D of these applications.

We require radiation sources for this novel method, and are now using cobalt-60 γ-ray and electron beams. We also expect to utilize high-level radioactive wastes as the sources in the near future. When this utilization is possible, a highly sustainable reaction process “for the waste by the waste” will be realized. We are also doing some investigations by using the practical radioactive wastes.

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Reference

Nagaishi, R. et al., Radiation-Induced Catalytic Reduction of Chromium(Ⅵ) in Aqueous Solution Containing TiO_2, Al_2O_3 or SiO_2 Fine Particles, Radiation Physics and Chemistry, vol.75, no.9, 2006, p.1051-1054.