

Arc Plasma Waste Treatment Technology



Background

Construction of a resource-circulating society is desired. An arc plasma heating technology can melt waste by its high temperature to achieve volume reduction and detoxifying. Therefore, it is possible to make efficient use of final disposal sites. For example, many local government have introduced plasma melting facilities for municipal waste incineration ash in recent years.

On the other hand, the arc plasma ignited under low-pressure atmosphere can remove metal oxide film on the metal substrate without heavily damaging metal. CRIEPI has been studying (i) Evaluation of application of arc plasma technology to radioactive waste melting treatment, (ii) Detoxifying and recycling of asbestos waste, (iii) Removing technology of radioactive metal oxide film of radioactive waste (Decontamination technology).

Principal results

(1) Evaluation of application to the melting technology with high volume reduction for low-level radioactive waste

We clarified that arc plasma melting technology is applicable to melting treatment for low-level miscellaneous radioactive waste based on experimental results of leaching rates of radioactive nuclides from solidified products, and migration behavior of radioactive nuclides in melting. A series of these results contributed to progress in practical use of plasma melting treatment for low-level miscellaneous radioactive waste.

(2) Detoxifying and recycling technology of asbestos waste

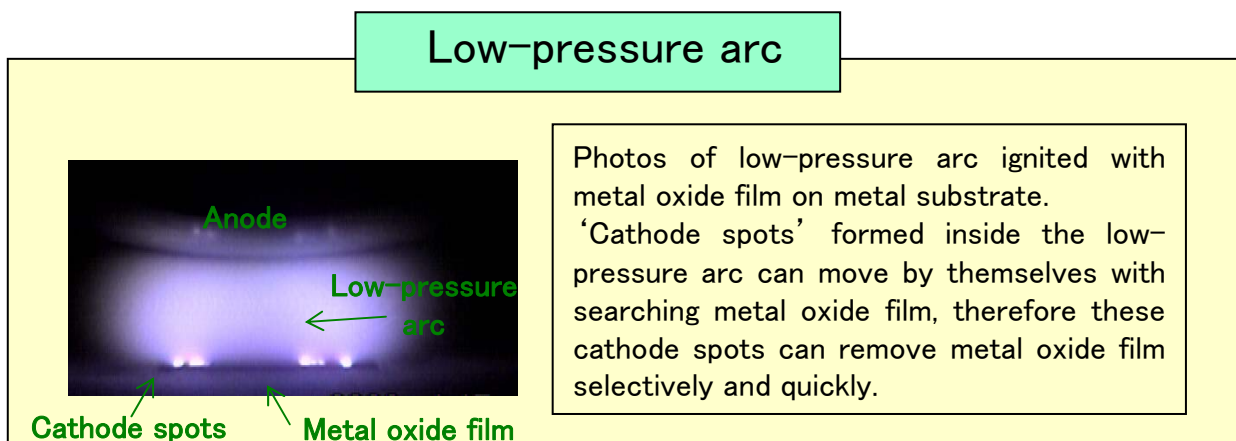
Melting asbestos waste promises to offer rocky or glassy safe slag. We clarified that plasma melting technology can be applied to detoxifying various asbestos waste. In addition, slag after melting asbestos waste can be recycled as roadbed materials and fine aggregates for concrete effective.

(3) Radioactive cobalt decontamination performance

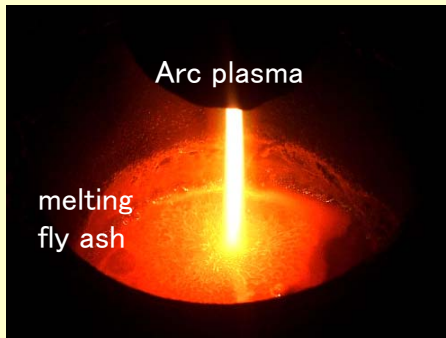
Test pieces with corrosion products film were made under the conditions simulating primary-coolant system of atomic power plant. We clarified that more than 90% of cobalt in the test pieces can be removed.

Future Developments

Surface decontamination technology for radioactive waste by low-pressure arc will be enhanced.



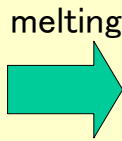
Arc plasma melting technology



Aspects of melting fly ash by arc plasma. Center region colored white is arc plasma with the temperature of more than 10,000°C. Orange colored region is melting fly ash with the temperature of around 1,550°C.



Asbestos fibers



(rocky slag)



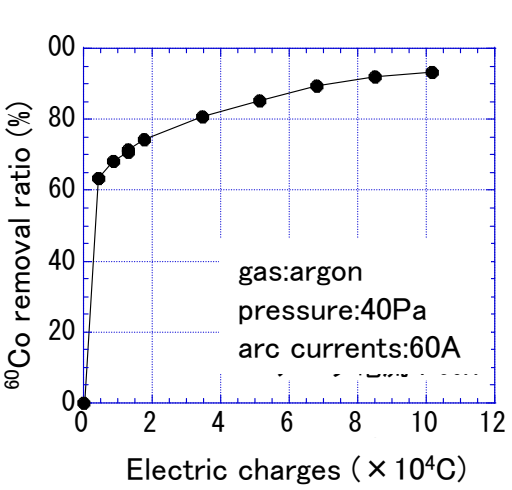
(glassy slag)

- (1) Harmful asbestos fiber disappeared and became rocky or glassy slag by plasma melting.
- (2) The slag satisfied the standard for sub-base course material by mixing crushed stone with particle size under 5mm. It can achieve the same mechanical strength as natural sand when used as aggregate for mortar.

Surface decontamination technology

	Photos	SEM photos
Before		
After		

Photographs of test pieces before and after low-pressure arc treatment. Metal oxide film formed under the conditions simulating primary-coolant system of atomic power plant was removed by low-pressure arc. Metallic luster can be observed after removing of black metal oxide film in left-hand photo. Grain boundary of crystal of corrosion products film disappeared in right-hand SEM photo.



Pipe with corrosion product film including cobalt-60

Low-pressure arc was applied to pipe shaped test pieces with corrosion products film including cobalt-60 on its inner surface. Repetition of low-pressure arc treatment can improve the cobalt-60 removal ratio, and finally more than 90% of Co-60 removal ratio was achieved.