Taiheiyo Cement Corporation

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Ministry of Land,Infrastructure,Transport and Tourism
NETIS
KT-140040-A

Agricultural and Rural Development Information Center
NNTD.1117

Heavy Metal Immobilization Material

DENITE

Taiheiyo Cement Corporation

What is Denite®?

Denite is a heavy metal immobilization material consisting primarily of magnesium oxide. It offers exceptional immobilization characteristics across the board for Class 2 specified toxic substances (such as heavy metals) designated by the Soil Contamination Countermeasures Act. It can also be used in immobilization treatment of soil that has been contaminated by multiple heavy metals.

Suitability for use with soils contaminated with various heavy metals

Denite offers exceptional immobilization characteristics across the board for Class 2 specified toxic substances (such as heavy metals) designated by the Soil Contamination Countermeasures Act. It can also be used in immobilization treatment of soil that has been contaminated by multiple heavy metals.

Simple application using conventional techniques

Denite can be applied using conventional soil improvement techniques, as either a powder or a slurry(except Denite MP).

Meticulous quality control to ensure a reliable, consistent supply

Thanks to a quality control system designed to ensure immobilization performance and a robust supply system, Taiheiyo is able to provide a reliable and consistent supply of Denite.

Product line

The Denite series of products, which has been certified under NETIS (New Technology Information System) and other third-party regimes, can be used to meet a variety of site needs. In addition to the Denite range of products, Taiheiyo also provides a range of application-specific specialty products. Please contact us for more information.

- **Denite** General-purpose immobilization material; suitable for use in a broad range of applications as an adsorbent
- **Denite CR** Effective for use with soil and industrial byproducts that contain high concentrations of hexavalent chromium or mercury
- **Denite MP** Suitable for use in immobilization and remediation applications at neutral pH levels(5.8 to 8.6)

Product	Target elements								
	Pb	Cd	Hg	As	Se	Cr(Ⅵ)	F	B	CN
Denite®	◎	◎	○	◎	○	○	◎	○	○
Denite CR®	○	○	◎	○	○	◎	○	○	◎
Denite MP®	◎	○	○	◎	○	◎	◎	○	○

◎ : Highly effective ○ : Effective

【Adsorption layer application technique】

【Appearance of Denite】

Technical certifications:Denite series

Denite has been registered as a new technology with numerous public agencies.

Agency	Name of registration regime	Year of registration	Registration number
Ministry of Land, Infrastructure, Transport and Tourism	New Technology Information System (NETIS)	2014	KT-140040-A
Agricultural and Rural Development Information Center	Nougyou-Nousonseibi Technical Information Database	2014	1117
Construction Management Bureau, Hokkaido Construction Department	New Technology Information System	2014	20141003
Miyazaki Construction Technology Promotion Organization	New Technology Promotion System	2014	279-1256
Tokyo Bureau of Construction	New Technology Information Database	2016	1601006

General-purpose Denite

Denite offers the following primary features:

- Can be used with low-alkaline soil (pH level of approx.10).
- Offers immobilization benefits immediately after mixing.
- Patented formulation is subject to a quality control program that includes immobilization performance.

Immobilization mechanisms

Denite immobilizes heavy metals and other hazardous substances in contaminated soil by means of the following mechanisms.

1. The product forms a stable, insoluble hydroxide with heavy metals and other toxic substances to prevent elution.
2. Cations from Denite form insoluble salts with heavy metals and other toxic substances to prevent elution.
3. Heavy metals and other toxic substances are adsorbed by Denite's hydration products and fixed in crystals to prevent elution.

Mechanism	Principal immobilized elements*1
Formation of insoluble peroxide	Lead, cadmium, mercury, etc.
Formation of insoluble salts	Arsenic, selenium, boron, etc.
Adsorption by hydration products and fixation	Arsenic, selenium, fluorine, hexavalent chromium, etc.

*1 Kojima, Oshima, Matsuyama, Moriya: "Description of Magnesium Oxide Insolubilization Mechanisms" Journal of the Society of Inorganic Materials, Japan. Vol. 19, pp. 15-23(2012)

Example applications (immobilization treatment)

The following table provides examples of immobilization treatment of a variety of contaminated soils with Denite.

Soil	Concentration category (Standard value)	Target element		Amount of Denite*1 (kg/m²)	Elution amount (mg/L)*2			pH (Test liquid)
					Before Immobilization treatment	After immobilization treatment	Soil elution amount standard	
1	Low concentration Less than 5x	Lead	Pb	30	0.026	<0.001	0.01	10.1
2		Arsenic	As	50	0.028	0.002	0.01	10.0
3		Fluorine	F	50	1.8	0.15	0.8	10.0
4		Boron	B	100	3.0	0.41	1.0	10.0
5		Mercury	Hg	100	0.0018	<0.0005	0.0005	9.9
6		Hexavalent chromium	Cr(Ⅵ)	100	0.12	0.03	0.05	10.4
7		Cyanogen	CN	100	0.20	0.026	Not detected	10.3
8		Selenium	Se	150	0.036	0.006	0.01	10.6
9	Medium concentration 5x or greater	Lead	Pb	50	0.12	<0.01	0.01	10.7
10		Arsenic	As	100	0.20	0.003	0.01	10.4
11	High concentration Greater than No.2 elution amount standard	Lead	Pb	100	1.6	<0.01	0.01	10.6
12		Cadmium	Cd	100	0.36	0.002	0.01	10.2
13		Fluorine	F	200	25.2	0.7	0.8	10.7

*1 The amount of Denite required varies with factors such as the nature of the contamination (type and concentration of contaminants, etc.) and the treatment method.
*2 Elution test method based on the technique described in Ministry of the Environment Notification No.18 (March 6, 2003).

Immobilization effects under acidic/alkaline conditions

Denite has been confirmed to deliver stable immobilization effects despite external factors such as acidic or alkaline conditions.

Soil	Target element		Amount of Denite (kg/m²)	Elution amount (mg/L)				
				Before Immobilization treatment	After immobilization treatment			Soil elution amount standard
				Ministry of the Environment Notification No.18*1	Ministry of the Environment Notification No.18	Addition of sulfuric acid*2	Addition of hydrated lime*2	
A	Lead	Pb	100	0.10	<0.01	<0.01	<0.01	0.01
B	Arsenic	As	100	0.11	0.008	0.008	0.007	0.01
C	Fluorine	F	100	2.64	0.2	0.2	0.2	0.8

*1 Based on Ministry of the Environment Notification No. 18 (March 6, 2003).
*2 Based on Geo-Environmental Protection Center GEPC/TS-02-S1 (March 7, 2008).

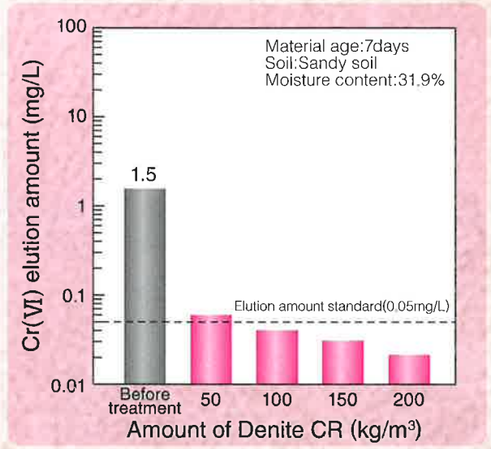
Denite CR®

Denite CR offers the following primary features:

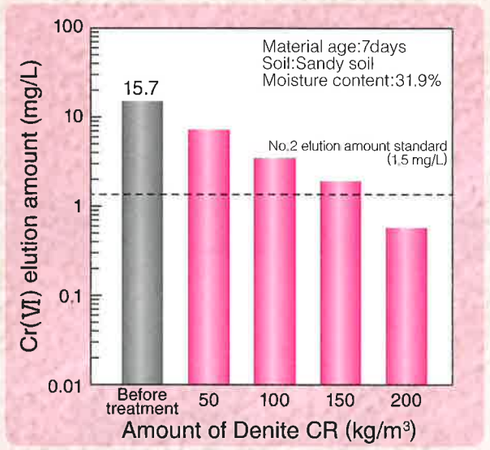
- Can be used to treat high concentrations of hexavalent chromium.
- Reduction effects allow stable immobilization.
- Is effective in immobilizing industrial byproducts.

Example applications (immobilization treatments)

The following graphs illustrate the results of immobilization treatment of soil contaminated with hexavalent chromium using Denite CR.



【Target value:Elution amount standard】



【Target value:No.2 elution amount standard】

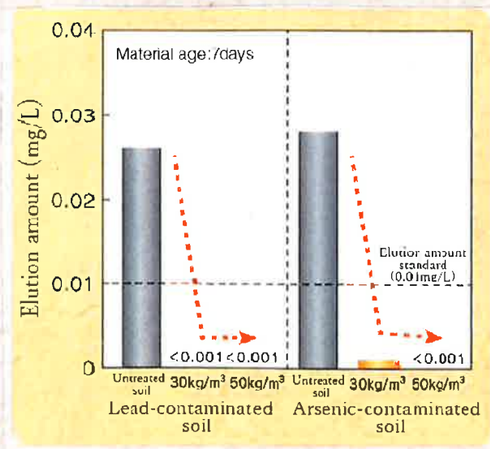
Denite MP®

Denite MP offers the following primary features:

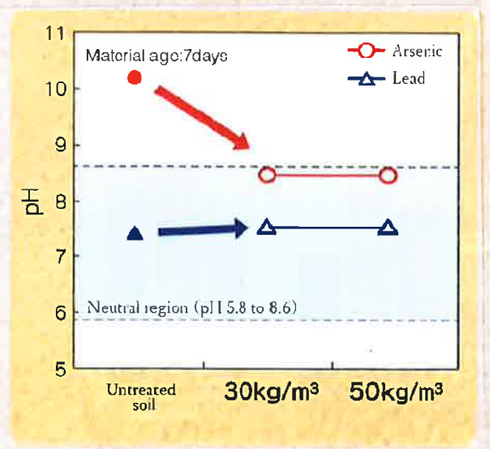
- Can be used in applications at neutral pH levels (5.8 to 8.6).
- Can immobilize all Class 2 specified toxic substances.
- Can be used in remediation applications with a cone index of 200 kN/m² or greater.

Example applications (immobilization treatment)

The following graphs illustrate the results of immobilization treatment of a variety of contaminated soils with Denite MP.



【Example of immobilization treatment】



【Example of pH testing】

Denite variants for specialized applications

- **Denite HF** Effective for soil containing high concentrations of fluorine or boron
- **Denite LS** Immobilization material derived by reducing the strength of the general-purpose variant (Denite)
- **Denite OI** Suitable for applications requiring both oil film reduction and immobilization
- **Denite SE** Effective for soil containing high concentrations of selenium

Product	Target elements								
	Pb	Cd	Hg	As	Se	Cr(Ⅵ)	F	B	CN
Denite HF®	○	◎	○	◎	○	○	◎	◎	○
Denite LS®	◎	○	○	◎	○	○	○	○	○
Denite OI®	◎	◎	○	◎	○	○	◎	○	○
Denite SE®	◎	○	○	◎	◎	○	○	○	○

◎ : Highly effective ○ : Effective

Application of the product

▲Application using a self-propelled soil improvement machine (powder addition)

▲Application using a bucket stabilizer (powder addition)

▲Application using a stabilizer (powder addition)

▲Application as a slurry
*Pictured:Slurry preparation

Handling precautions

[Safety measures]
Use protective gloves, protective clothing, protective eyewear, and a protective mask. Wash hands and face thoroughly after handling.

[First aid]
In case of inhalation, move the victim to a location with fresh air and have him or her rest in a posture conducive to easy breathing. In case of skin (or hair) exposure, wash thoroughly with water for several minutes and seek medical attention immediately. In case of ingestion, rinse mouth thoroughly and seek medical attention immediately.

[Storage]
Store so that the product is accessible only to authorized personnel. Keep dry.