

## Taiheiyo Cement Obtains ETV Mark from Ministry of the Environment for its Ceraclean® Water Purification Material

Taiheiyo Cement Corporation (Head office: Minato-ku, Tokyo; President: Masafumi Fushihara; hereinafter, the “Company”) is pleased to announce that it has obtained ETV Mark (Environmental Technology Verification\*) certification from Japan’s Ministry of the Environment (MOE) for its “Environmental Improvement Technology Using Ceraclean®.” The Company applied to the MOE-run ETV Mark scheme in the field of water environment improvement technology for enclosed coastal sea areas, and subsequently obtained certification (Verification No. 090-1701) from MOE for its technology as an environment improvement technology for mudflats on May 14, 2018, following a series of validation tests.

Mudflats are important natural environments that fulfill a variety of functions, including nurturing the development of numerous living creatures, providing fishing grounds and maintaining water quality. In recent years, however, mudflat environments have deteriorated, with the buildup of sludge resulting in the release of foul odors, and over the past 20 years the number of sound and healthy mudflats has fallen to around a quarter of past levels (according to a 2008 survey by the Fisheries Agency). As a result, this environmental degradation is affecting the fishing industry and local food culture, with annual catches of clams that inhabit these mudflats falling to around just 30% of the 200,000 tons/year of 20 years ago. Clams also have the important function of filtering seawater and contribute to stabilizing water quality in these areas, and so mudflat environments have continued to deteriorate as a result of the decline in their numbers. In light of this problem, as of FY2016, the Company commenced the development of an improvement technology for mudflats, combining the application of its Ceraclean® water purification material onto mudflats and “plowing-in” as used in agricultural work.

Ceraclean® is a slightly alkaline, porous material, composed mainly of silicate and calcium. By plowing it into mudflat environments that are deteriorating due to the buildup of sludge, etc., it is expected that they can be restored to sound and healthy mudflat environments.

The Company applied for this technology to become part of the MOE ETV program in FY2017. The application was accepted, and mudflat improvement tests were later conducted under expert guidance by a third party organization, at Mutsu Bay in Aomori Prefecture. As a result of these tests, the improvement effects to the mudflat environment were verified, culminating in the Company obtaining ETV Mark certification. (Please refer to the attachment for further details.)

As a result of the Company obtaining ETV Mark on this occasion, it is hoped that the widespread popularization of this technology will contribute to the regeneration of deteriorating mudflat environments. The Company will aim to achieve the widespread popularization of Ceraclean® water purification material and contribute to the recovery of local fishing industries and food culture through the regeneration of clam stocks and other aquatic resources. Moving forward, the Company will continue to develop and provide products and technologies that contribute to the conservation of natural environments and local economies.



**Ceraclean® plowing on mudflats**



**ETV Mark**

\* ETV (Environmental Technology Verification): an MOE program under which third party organizations contracted by MOE conduct verification testing in actual environments to assess the environmental conservational benefits, etc., of useful advanced environmental technologies that have already been put to practical use. The program seeks to establish methods and frameworks for verifying environmental technologies, encourage the widespread popularization of such technologies, and promote the advancement of environmental conservation and environmental industry.

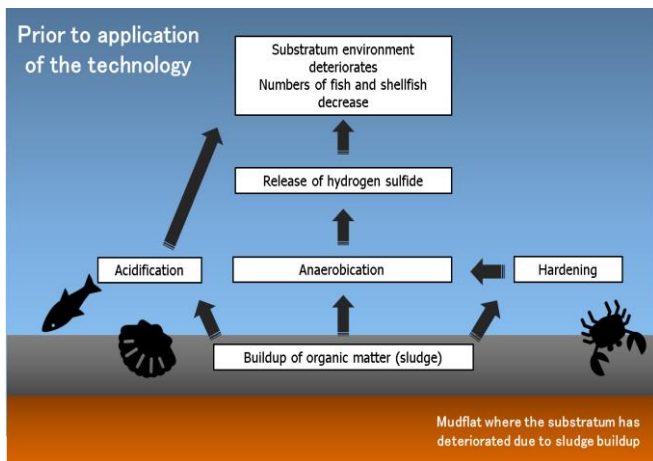
<Attachment>

## 1. Mechanism for improving mudflats using this technology

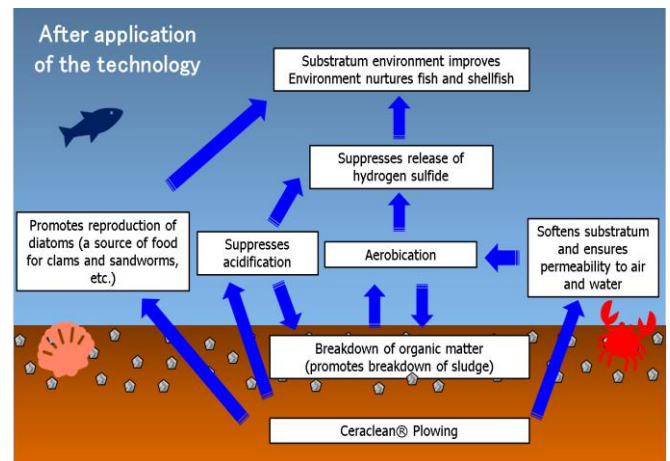
**Figure 1** shows mudflats where the bottom sediment (or “substratum”), which is an essential constituent of the mudflat, has deteriorated. **Figure 2** shows a mudflat where the environment has been improved using Ceraclean® technology. In mudflats where the substratum has become acidified and dysoxic (poorly oxygenated) due to the buildup of sludge, the substrate environment continues to deteriorate, and it becomes impossible for fish and shellfish to inhabit it.

By contrast, plowing Ceraclean® into mudflats where the substrate environment has deteriorated (1) softens the substratum ensuring permeability to air and water (thereby improving the dysoxic state), (2) counteracts acidification of the substratum due to its alkaline nature (thereby encouraging the breakdown of sludge), and (3) promotes the growth of diatoms\* due to silicate elution effects, which clams and other fish and shellfish feed on. As a result of these benefits, Ceraclean® is expected to contribute to the regeneration of sound, healthy mudflats where creatures such as clams and sand worms and seaweed species such as eelgrass can live.

\*Diatoms: Diatoms are a type of phytoplankton. They are a source of food for clams, shrimp, sand worms and other organisms that inhabit mudflats.



**Figure 1 –Mudflat environment where the substratum has deteriorated (prior to application of Ceraclean® technology)**



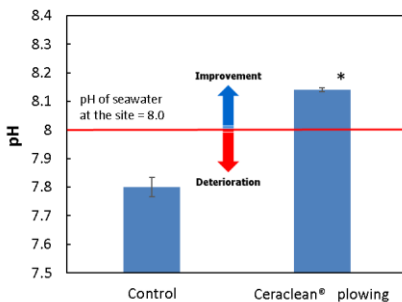
**Figure 2 –Mudflat environment improved using Ceraclean® technology**

## 2. ETV program verification results

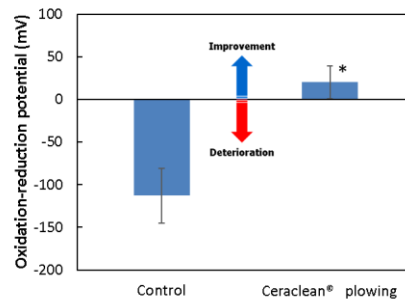
300kg/a (a = 100m<sup>2</sup>) of Ceraclean® was plowed into an area of tidal mudflat where the substratum was found to be in an acidified, dysoxic state. A study of the area 3 months after the application of Ceraclean® revealed the following: (1) pH increased by 0.3, improving to approximately the same pH value as seawater (an improvement with regard to acidification), (2) the oxidation-reduction potential rose significantly to 130mV (suppression of the generation of harmful hydrogen sulfide), and (3) the concentration of dissolved silicate in the substratum rose to 1.6 times previous levels (suggesting the reproduction of diatoms). (See **Figures 3 to 5**.)

In parallel with the ETV program tests, the Company also conducted its own voluntary tests, burying clams in the testing area and investigating the state of their growth. In observations carried out 10 months later, the healthy growth of clams was observed in the area where Ceraclean® was applied, and a high result of 93% was obtained for survival rates (**Figure 6**).

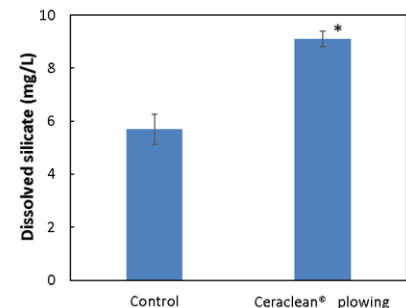
\*There is a significant difference at the 5% level (\*:p<0.05)





**Figure 3 – Substratum pH (indicator for acidification)**



**Figure 4 – Substratum oxidation-reduction potential (indicator for state of dysoxia)**



**Figure 5 – Dissolved silicate concentration**

	Control	Ceraclean® plowing
External appearance of clams		
	Areas plowed with Ceraclean® nurture healthy clams with no blackening of shells.	
Survival rate	40%	93%

**Figure 6 – State of development of clams 10 months after Ceraclean® plowing (according to a survey by the Company)**