

Field Study on the Influence of Floating Mud on the Long-Term Performance of Sand Capping Technique on Nutrient Release Reduction

Norio Katakura
Technology Center, Taisei Corporation
Tokyo, Japan

Kazuo Murakami
Tokyo City University
Kanagawa, Japan

Nutrients released from the contaminated bottom sediments on the seabed are widely known to be a source of water pollution. In order to minimize contaminant release from the sediments, the sand capping technique has been utilized in several coastal regions in Japan. However, the effectiveness of this technique has seldom been questioned due to new deposition on the seabed. This study describes the long-term performance of the sand capping technique on nutrient release reduction from contaminated bottom sediments in field experiments at the MM21 district in Yokohama Port. From the study, it is found that the effect of sand capping is maintained but is decreasing due to newly accumulated contaminated sediments on clean capping sand.

INTRODUCTION

Even in semi-enclosed coastal seas where eutrophication has progressed, such as Tokyo Bay, the water quality has been significantly improved by the substantial reduction of effluent load from the land. However, in the summer when the water quality becomes worse, red tide and blue tide are still observed frequently. The nutrient release from contaminated bottom sediments that had accumulated in the past is considered as one of the sources of the effluent load (Inoue and Nakamura, 2002a, 2002b, 2009; Cowan and Boynton, 1996; Nakamura et al., 1994, 2000; Natalia, 1999). In order to improve the sediment quality, the sand capping technique has been utilized in various locations all over the world. The purpose of the sand capping technique is to control not only the nutrient release from contaminated bottom sediments in Japan (Ishibashi et al., 2009; Kim et al., 2007; Ports of Fukuoka, 2005), but also the elution of the toxic substance in many other countries (Hull et al., 1999; Galvez-Cloutier et al., 2006; Palermo et al., 1998). The sand capping technique was conducted in the MM21 district at the Yokohama Port for The Sea Blue Project from 1994 to 1998 (Ports and Harbors Bureau, Ministry of Transport, 1993). The effect of the sand capping technique with clean sand on nutrient release reduction has been proved in various laboratory tests, such as those of The Sea Blue Project, and therefore considerable reduction can be expected (Horie et al., 1996; Research Council, Ports and Harbors Bureau, Ministry of Transport, 1985; Sumeri et al., 1994). Nevertheless, newly accumulated floating mud has been observed on the capping sand. Floating mud is moved easily by a flow and promotes consumption of the oxygen by the microbes. Therefore, the suppressant effect of the sand capping technique on the nutrient release from contaminated bottom sedi-

ments is decreasing and is assumed to be almost negligible in the end. From this viewpoint, the long-term performance of the sand capping technique on nutrient release reduction and its influence on the surrounding water quality is studied with the experiments in the field and the laboratory.

IMPLEMENTATION METHOD

Area of Field Study

The sand capping constructions in the MM21 district at the Yokohama Port were carried out from 1994 to 1998 for The Sea Blue Project, which aimed to improve the water and sediment quality in enclosed water and to create sea areas that are eco-friendly for nature, creatures, and humans (Ports and Harbors Bureau, Ministry of Transport, 1993). The sand capping construction zone is shown in Fig. 1. In order to reduce the nutrient release from bottom sediments, a 30-cm-thick sand-capping layer is required by the Ports and Harbors Bureau (Research Council, Ports and Harbors Bureau, Ministry of Transport, 1985). In the MM21 district, 30-cm-thick sand capping was planned and conducted. The sand capping thickness of about 30 to 50 cm was

Received December 8, 2013; updated and further revised manuscript received by the editors February 4, 2015. The original version (prior to the final updated and revised manuscript) was presented at the Twenty-third International Offshore and Polar Engineering Conference (ISOPE-2013), Anchorage, Alaska, USA, June 30–July 5, 2013.

KEY WORDS: Sand capping, contaminated sediment, nutrient release, floating mud.

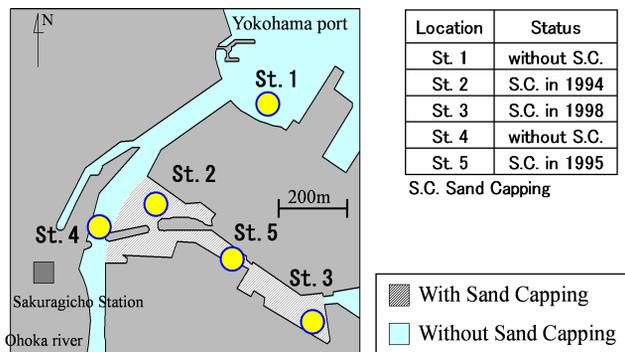


Fig. 1 Sand capping construction zone and measurement sites in the MM21 District