APPENDIX III

DEMAS

CORRELATION OF WATER APPEARANCE AND SUSPENDED SOLIDS CONCENTRATION IN DREDGING PLUMES

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CORRELATION OF WATER APPEARANCE AND SUSPENDED SOLIDS CONCENTRATION IN DREDGING PLUMES

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1 INTRODUCTION

During the sand dredging works some people, alarmed by the appearance of plume of suspended sediment, have been concerned about the environmental impact they might have.

Until now no data have been available on the relation between the concentration of suspended solids in the water and the appearance of the water particularly as seen from the air. The trial described in this report was designed to give an initial indication of the correlation between the two. DEMAS co-ordinated the execution of the trial for the Geological Engineering Office, of the Civil Engineering Department under Agreement CE 44/90, as part of the Fill Management Studies conducted by the FMC Secretariat.

The trial was executed at East Tung Lung Chau on 30 November, 1993 (map on page 14). Even before this first test was carried out it was proposed to hold a second and more detailed monitoring test, complementing the results of this first exercise. More data on the dredging processes and sediment overflow will be collected during the second plume monitoring test which is planned to be carried out during the spring of 1994.

When assessing the results of this first test it must be understood that little time was available for preparation. The trial was restricted to obtaining a simple correlation between plume visual impact and suspended solids, with no attempt to collect all the data necessary to model a dredging plume.

This report gives a factual summary of the results of the first test and some preliminary conclusions. Details of the measurements and laboratory tests carried out are presented in Annexes to the report.

2 OBJECTIVE

The main objective of the trial was to take water samples and photographs of a dredging plume simultaneously to correlate the appearance of the plume with different levels of suspended solids.

3 MONITORING OF THE DREDGING PROCESS

The plume monitoring test was carried out on 30 November 1993, during dredging by the Trailing Suction Hopper Dredger (TSHD) Antigoon at East Tung Lung Chau, for the West Kowloon Reclamation North - Phase II project. At the start of dredging, the TSHD Volvox Hollandia, working for the same project, had left the site half an hour before, leaving a fading plume behind. During most of the test, the Antigoon was the only dredger working in the area, and only at the end of the cycle was she accompanied by the TSHD Geopotes 15. However, the plumes of the Antigoon and the Geopotes 15 remained separate.

3.1 TRAILING SUCTION HOPPER DREDGER

The Antigoon has a hopper capacity of 8,400 m^3 and is equipped with a single drag arm with a suction pipe diameter of 1,200 mm. The diameter of the discharge pipe is 1,100 mm. The overall length of the dredger is 115 m and the breadth 22.60 m. The hopper itself is 49.0 m long and 16.80 m wide. The hopper has two vertical adjustable overflow outlets 10 m from each end, each with a diameter of 1,900 mm. The

5 SUMMARY AND CONCLUSIONS

5.1 The concentration of suspended solids near the water surface (0 - 1 m, details in APPENDIX III), measured within a distance of 100 m behind the dredger, ranges from 75 to 150 mg/l.

5.2 The concentration in the same part of the plume, also near the surface, drops to less than half the values indicated in conclusion 5.1, after some ten minutes.

5.3 Within less than 30 minutes the concentration in the plume, near the surface, levels out at a concentration of 20 to 30 mg/l.

5.4 The samples taken at depths from 3 to 6 m below the surface and approximately five minutes behind the dredger indicate concentrations ranging from 160 to 323 mg/l (B series, details in APPENDIX III).

5.5 The samples of the A series (details in APPENDIX III) give very irregular readings of concentration, although the general level at a depth from 1 to 9 m below the surface are marginally higher than the near surface results. Taking into account the distance to the sail track of the dredger this erratic behaviour might be caused by the fact that the sample boat was just at the edge of the plume.

5.6 The samples of the C and D series (details in APPENDIX III) at a depth between 1 and 12 m below water surface give very low readings, ranging from 10 to 20 mg/l. The samples have been taken some 15 to 20 minutes behind the dredger.

5.7 The low readings in the E-series, which have been taken within 5 minutes behind the dredger, can be explained by the fact that the overflow of the dredger was not used for a few minutes.

5.8 The F, G, H and I series (details in APPENDIX III) of samples indicate a concentration ranging from 6 to 40 mg/l. These samples have been taken in a plume of 20 to 30 minutes old.

5.9 A general conclusion is that the concentration of suspended solids peaks around the dredger in the area influenced by the overflow. Some five minutes later, when the effect of the air entrapment on the movement of solids is over, the concentration drops sharply. After some 15 to 20 minutes the concentration is below 40 mg/l.

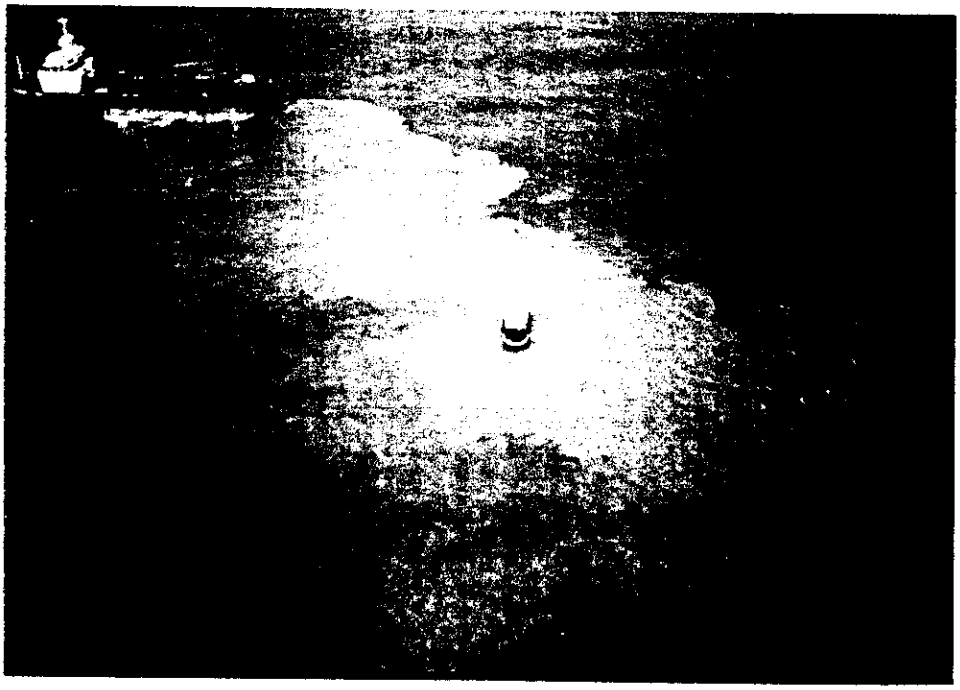
5.10 At present the conclusions are based on a limited number of readings. The numbers of samples in the depth range from 3 to 12 m is particularly low and not sufficient to form definite conclusions.

5.11 For the next investigation, scheduled for 24 February 1994, sampling in the period from 4 to 12 minutes behind the dredger would need extra attention.

5.12 The above conclusions are valid for the soil conditions dredged and the configuration of the dredger used.

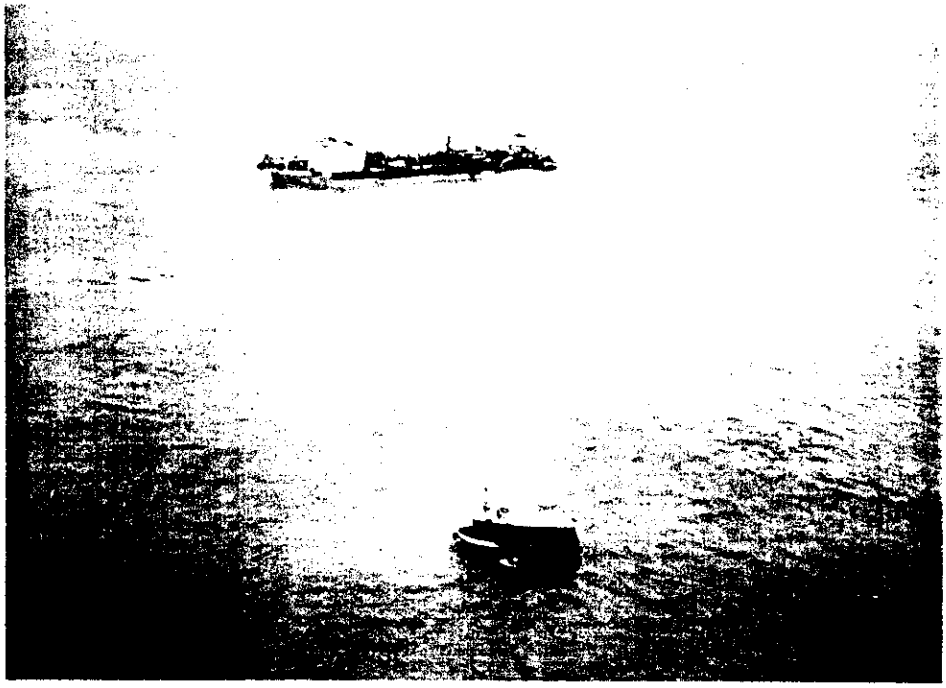
Picture 3: Survey boat takes sample in wake of dredger at the heart of the new plume
Suspended solids concentration 323 mg/l, sample depth 3 m
Sample B6 (E852.223, N812.566) at 9:01:22 AM

Film 8, frame 4; polariser filter on camera; Film type Kodak GA 100 ASA
30 November 1993, weather: overcast, flying at 400 ft



Picture 4: Survey boat takes sample in wake of dredger at the heart of the new plume
Suspended solids concentration 233 mg/l, sample depth 6 m
Sample B8 (E852.225, N812.557) at 9:01:45 AM

Film 8, frame 5; polariser filter on camera; Film type Kodak GA 100 ASA
30 November 1993, weather: overcast, flying at 400 ft

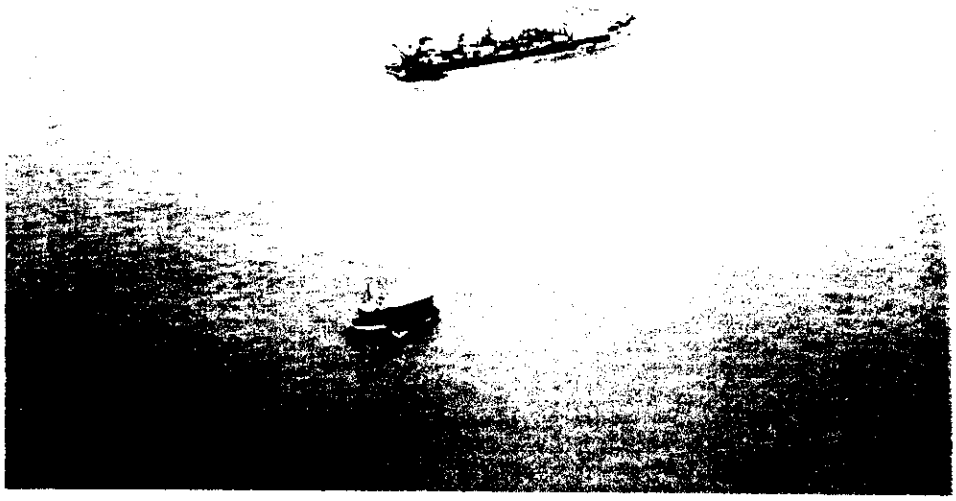


Picture 8: Survey boat takes sample in approximately 10 minutes old plume
Suspended solids concentration 44 mg/l, sample depth 0 m
Sample 44 (E852.254, N812.290) at 9:41:44 AM

Film 12, frame 2, no polariser filter on camera; Film type Kodak GA 100 ASA
November 1993, weather: overcast, flying at 400 ft

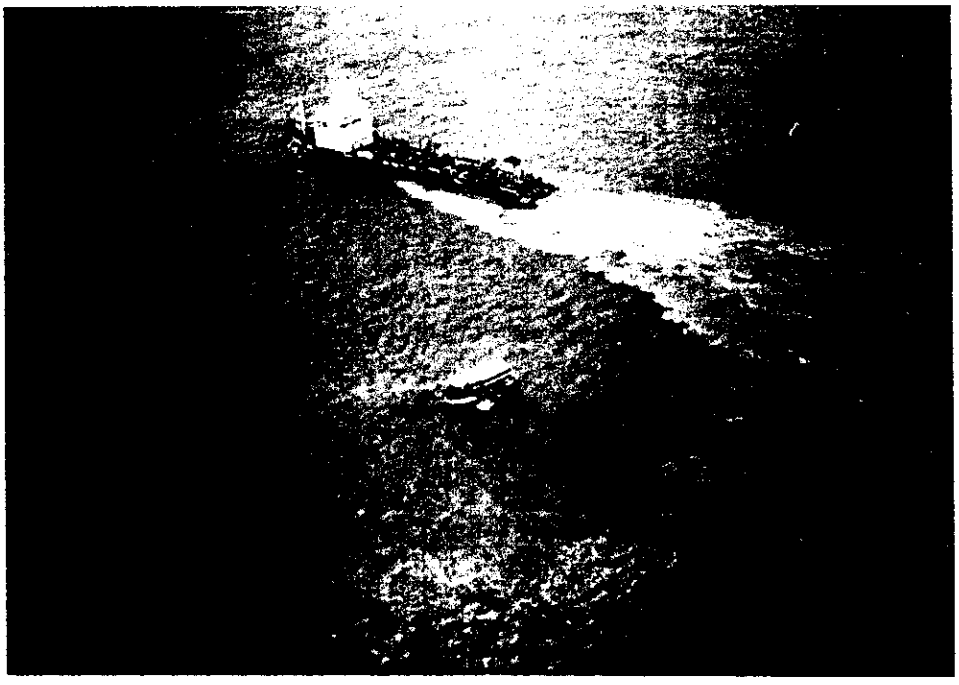
Picture 9: Survey boat takes sample in approximately 10 minutes old plume
Suspended solids concentration 44 mg/l, sample depth 0 m
Sample 44 (E852.254, N812.290) at 9:41:44 AM

Film 12, frame 3, no polariser filter on camera; Film type Kodak GA 100 ASA
30 November 1993, weather: overcast, flying at 400 ft



Picture 14: Survey boat takes sample in old plume
Suspended solids concentration 10 mg/l, sample depth 0 m
Sample 38 (E852.064, N812.000) at 9:31:20 AM

Film 11, frame 13, no polariser filter on camera; Film type Kodak GA 100 ASA
30 November 1993, weather: overcast, flying at 400 ft



Picture 15: Survey boat takes sample in old plume
Suspended solids concentration 12 mg/l, sample depth 0 m
Sample 26 (E852.281, N812.296) at 9:16:36 AM

Film 10, frame 3, polariser filter on camera; Film type Kodak GA 100 ASA
30 November 1993, weather: overcast, flying at 400 ft