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Gas removal systems associated with dredge pump, Phase B, October,1965

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GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B

Status Report No. 8

Prepared by
Alfred Amatangelo
and
John B. Herbich

Prepared for
U. S. Army Engineers District, Philadelphia
Corps of Engineers
Philadelphia, Pennsylvania

October, 1965

Bethlehem, Pennsylvania

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PREFACE

The following status report summarizes the progress made under Phase C of the project during the period August 1, 1965 to September 30, 1965, at the Hydraulic and Sanitary Engineering Division of Fritz Engineering Laboratory, under the terms of contract No. DA-36-109-CIVENG-64-72. The progress on the study was reported in seven status reports dated February 1964, April 1964, October 1964, December 1964, January 1965, June 1965, and August 1965 (Fritz Laboratory Report No. 310.1[1]*, No. 310.2[2]*, No. 310.4[4]*, No. 310.6[5]*, No. 310.8[6]*, and No. 310.9[7]*.

Phase A and Phase B of the project were completed and summarized in Fritz Laboratory Reports No. 310.3[8]* and 310.7[9]* respectively.

Dr. John B. Herbich is the project director, and is assisted by Mr. A. Amatangelo, Instructor, and Mr. G. Bagge, and Mr. Robert E. Miller, Research Assistants. Professor W. J. Eney is Head of the Department of Civil Engineering and Fritz Laboratory and Dr. L. S. Beedle is the Director of Fritz Engineering Laboratory.

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*Numbers in parenthesis refer to references on pages 5 and 6.

I. INTRODUCTION

The scope of work under Phase C of the project is divided into two parts as follows:

Part I: Establishment of Test Set up of all machinery and equipment in preparation for experimental tests described under part 2. The model facility was designed to simulate existing suction pipe configuration on hopper dredges. Test equipment will include:

Dredge pump, transparent

Suction piping, transparent

Accumulator, transparent

Vacuum pump

Water ejector

Vacuum control equipment

Discharge piping

Tanks

Air compressor

Measuring equipment to measure dredge pump vacuum, pressure rpm, velocity,...etc.

Part II: Performance of test with water only. This part is further subdivided into two test series.

Test Series No. 1. This series will be performed without gas removal equipment. The object of this series will be to make general observations of the behavior of gas in the suction system when pumping clear water only; and to provide a reference for comparison of performance of systems with and without gas removal equipment, and to

determine the relationship between gas, pump speed and suction geometry that will cause complete collapse, if any, of the dredge pump.

Test Series No. 2. This series will be performed with gas removal equipment. The objective of this series will be determination of the effect of gas content, suction geometry, and speed on the gas removal system; comparison of the effect of two types of evacuators, vacuum pump, and water ejector, on the performance of the gas removal system; and the comparison between the effect of constant and fluctuating water level in the accumulator on the performance of the gas removal system.

II. EQUIPMENT ORDERED

The following equipment was ordered. The list includes only those items which are necessary to conduct Test Series No. 1.

1. Bronze-plexiglas pump casing
2. Two Mechanipak seals
3. Plexiglas tubing & flanges for suction line
4. One 12-inch gate valve
5. One 6-inch gate valve
6. Two 50-inch range manometers
7. One 100-inch range manometer
8. Five pints Meriam measuring fluid
9. Five pounds Mercury
10. One - 4 1/2 inch (0-30 in. Hg. range) vacuum gauge
11. One - 4 1/2 inch (0.epsig) pressure gauge
12. 7.5 HP air compressor [1]
13. Two Air Flow meters (3.18-31.8scfm)
14. One Air Flow meter (0.71-7.1scfm)
15. Pressure Relief Valve
16. Thermometers
17. Clear Plastic sheets
18. Steel plates, bolts, nuts, gaskets
19. Steel piping

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[1] Some accessories to the basic compressor have not been received.

III. PROGRESS ON INSTALLATION

1. Covers for tank A are 100% completed.

2. Due to a delay in shipment the 7.5 HP air compressor did not arrive until September 9, 1965. Some accessories such as starting switch, piping, aftercooler and dryer have not arrived. The compressor and motor have been lined up and grouted into place.

3. Bronze-plexiglas pump casing arrived August 20, 1965 and has been properly installed. Also the acrylic plastic suction line and piezometric taps have been installed.

4. The plexiglas-bronze impeller No. TD7 was damaged and had to be sent to Industrial Models Company for repair. A bronze impeller No. TD7 will be used for the calibration tests in place of the acrylic plastic-bronze impeller.

5. Pressure Control valve, flowmeter, control valves, and pressure gage have been installed on tank A.

6. All piping and tanks have been painted.

7. The dredge pump motor and the magnetic flowmeter have been connected electrically and are ready for operation. In addition the tackometer has been installed and is ready to be connected to the motor.

8. We have been informed by the sponsor that the head losses for the drag head are estimated at .3 $V^2/2g$. It appears this cannot be achieved with an orifice, since even at high Reynold's Numbers the head loss for an orifice at an inlet is approximately 0.6 $V^2/2g$. If at pump design conditions a rounded inlet was provided instead of an

orifice the head loss could be reduced. However, at other than design conditions the orifice will be used, and the higher head loss must be considered in the analysis of the performance data.

Possibly additional investigation will uncover information leading to an alternate solution to this problem.

9. The air will be introduced at four points around the circumference of the suction line, at a distance of 1.50 inches downstream from the entrance of the suction line.

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