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

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HYDRAULIC AND SANITARY ENGINEERING DIVISION

GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B

Status Report No. 6

Prepared by

Adnan Shindala
and
John B. Herbich

Prepared for

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

June 1965

Bethlehem, Pennnsylvania

Fritz Engineering Laboratory Report No. 310.8

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PREFACE

The following status report summarizes the progress made under Phase C of the project during the period March 6, 1965 to May 31, 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 five status reports dated February 1964, April 1964, October 1964, December 1964, and January 1965 (Fritz Laboratory Reports No. 310.1(1)*, No. 310.2(2)*, No. 310.4(3)*, No. 310.5(4)*, and No. 310.6(5)*.

Phase A and Phase B of the project were completed and summarized in Fritz Laboratory Reports No. 310.3(6)* and 310.7(7)* respectively.

Dr. John B. Herbich is the project director, and Dr. Adnan Shindala is the project supervisor. They are assisted by Mr. A. Amatangelo, Instructor, and Mr. G. Bagge, Research Assistant. 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 page 7.

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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 contents 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 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 value
5. One 6-inch gate value
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 (0-3psig) pressure gauge
12. 7.5 HP air compressor
13. Two Air Flow meters (3.18-31.8scfm)
14. One Air Flow meter (0.71-71 scfm)
15. Pressure Relief Valve
16. Thermometers
17. Clear plastic sheets
18. Steel plates, bolts, nuts, gaskets
19. Steel piping

III. PROGRESS ON INSTALLATION

1. The suction tank A and the discharge tank B are both cleaned and moved to their proper positions.

2. Windows are cut into the suction tank as well as the discharge tank and prepared for installation of plexiglas sheets.

3. The foundation for pump and motor was completed. The pump and motor were installed on the new base.

4. Covers for tank A are 65% completed.

5. Extension of tank B is 85% completed.

6. Mud was removed from tanks A and B and tanks were prepared for painting.

IV. COMMENTS ON LETTER OF MARCH 31, 1965 FROM THE U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA

(A) The proposed use of a pressure relief valve at the end of the discharge line is questioned for the following reasons:

(1) A pressure relief valve cannot maintain both an upstream pressure of 50 psia and a downstream pressure of 15.7 psia, the indicated required performance as stated in the report.

(2) To properly simulate dredging operations any device installed in the discharge line must not be adjustable. A nozzle or orifice, if necessary to develop pressure drop would be preferable. Furthermore, such a restriction could serve as a supplementary two phase flow study device.

(3) Mechanical parts of such devices in the flow would be subject to possible damage in the event testing with solids-water mixtures is undertaken later.

COMMENT

(1) The pressure relief valve is planned to be located at the discharge tank rather than at the end of the discharge line. Such location of the pressure relief valve is believed to aid in reducing the pressure in the discharge line.

(2) The idea of using an orifice or a nozzle at the end of the discharge line to aid in reducing the pressure seem attractive and will be given further consideration when testing starts and the pump is in operation. On the other hand, the use of such devices at the end of the discharge line might result in complicating the test procedure since different size orifices would be required for different conditions.

(B) Referring to the proposed data sheet on page 15, the following is noted:

(1) The air flow in cfm should be referenced to an appropriate base, i.e. either standard air condition or the pressure and temperature under which the actual measurements are taken.

(2) The references for suction and discharge heads should be indicated, i.e. either corrected to centerline of pump or identified as to location with respect to pump.

(3) The dredging depth, level of water in suction tank, should be maintained at the same constant level throughout the entire test series.

COMMENTS

(1) Columns for recording the air pressure and temperatures are provided in the proposed data sheet which will aid in transforming the air flow from cfm to scfm at a later time.

(2) Discharge and suction heads will be recorded as read on manometers. The computer program will be written so that corrections in readings to the centerline of the pump will be made automatically.

(3) It is planned to maintain a constant dredging depth and water level in the suction tank throughout the entire tank series.

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