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Gas removal system associated with dredge pump: Phase C status report no. 10, February 1966

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GAS REMOVAL SYSTEM ASSOCIATED
WITH DREDGE PUMP: PHASE C

Status Report No.10

Prepared by
Alfred Amatangelo
Robert E. Miller
and
John B. Herbich

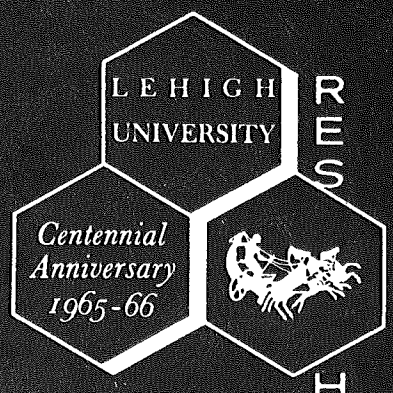
Prepared for
U. S. Army Engineers District, Philadelphia
Corps of Engineers
Philadelphia, Pennsylvania

February, 1966

Bethlehem, Pennsylvania

Fritz Engineering Laboratory Report No. 310.13

LEHIGH UNIVERSITY - FRIEZE



CIVIL ENGINEERING DEPARTMENT
FRITZ ENGINEERING LABORATORY
HYDRAULIC AND SANITARY ENGINEERING DIVISION

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WITH DREDGE PUMP; PHASE C

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PREFACE

The following status report summarizes the progress made under Phase C of the project during the period December 1, 1965 to January 31, 1966, at the Hydraulic and Sanitary Engineering Division of the Fritz Engineering Laboratory, under the terms of contract No. DA-36-109-CIVENG-64-72. The progress on the study was reported in nine status reports dated February 1964, April 1964, October 1964, December 1964, January 1965, June 1965, August 1965, October 1965, and December 1965, (Fritz Engineering Laboratory Report No. 310.1^{(1)*}, No. 310.2⁽²⁾, No. 310.4⁽³⁾, No. 310.5⁽⁴⁾, No. 310.6⁽⁵⁾, No. 310.8⁽⁶⁾, No. 310.9⁽⁷⁾, No. 310.10⁽¹⁰⁾, and No. 310.11⁽¹¹⁾.)

Phase A and Phase B of the project were completed and summarized in Fritz Engineering Laboratory Report No. 310.3⁽⁸⁾ (June 1964), and No. 310.7⁽⁹⁾ (February 1965) respectively.

Dr. John B. Herbich is the project director, Mr. A. Amatangelo is the project supervisor and are assisted by Mr. G. Bagge and Mr. Robert E. Miller, Research Assistants. Dr. L. S. Beedle is Acting Head of the Department of Civil Engineering.

*Numbers in parenthesis refer to references on pages 8 and 9 .

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I. Progress on Installation

1. The compressor unloading valve was installed in order to exhaust excessive compressed air.

2. Thermometers were installed in the compressor system to measure discharge air and discharge cooling water temperatures. Also, an automatic flow regulator was installed in the cooling water line to insure safe operating temperatures for the compressor.

3. The electrical contractor connected the compressor "start-stop" switch. When a test run was made, the switch overheated and seriously damaged the solenoid in the switch. A check of the wiring indicated that the switch was improperly wired for only 120 volts instead of the required 240 volts. The contractor temporarily repaired the switch and ordered a new solenoid at his own expense.

4. A sight glass was installed in Tank B to facilitate monitoring the dredging depth.

5. The compressor was delivered with an exposed V-belt drive for its lubricator system. For safety reasons, it was necessary to fabricate a metal guard to cover the moving belt.

6. Early runs with the dredge pump indicated that water was getting into the air flowmeter on Tank A. The elevation of the flowmeter was increased and this seems to have alleviated the problem.

7. During a test run an excessive pressure in Tank A broke one of the angle braces inside the tank. This overloaded the other braces and all three angle braces broke loose causing excessive leakage. It was necessary to remove the top of Tank A and weld four new angle braces into position.

8. Early runs indicated that not enough compressed air was getting into the suction line. The system was drained and sixteen new holes were drilled in the flange at the entrance to the suction pipe. These holes were connected with plastic tubing to a manifold and thence to the air supply.

9. At low air flows into the suction line the indicated air pressure was zero. Investigation indicated that at low air flows a vacuum exists in the air line. Both a pressure gage and a vacuum gage are now installed on the air supply line.

10. It was found that the pump stalled at lower air flows than anticipated. In order to get accurate air flow data it was necessary to install a lower range air flow meter in parallel with the higher range air flow meter.

II. Experimental Investigation

1. Experimental Methods

Presented on Figure 2 are the model dredge pump characteristics determined from testing with water and no air injection. The purpose being to determine the basic characteristics of the model dredge pump a similar pump investigated under a previous contract and for possible comparison with future tests. An obvious deviation appears between the present plexiglas-bronze model and characteristics obtained from model pump characteristics ⁽¹²⁾. The deviations from the model pump characteristics in the present experimentation may be due to the following:

Head

1. The present model pump has a rougher volute casing than the previous model pump which could cause a decrease in head for increased flow.

BHP

1. The increase in BHP may be due to an ammeter error.
As soon as possible a calibration check will be made of the ammeter now being used to insure that all possible error is eliminated.
2. In addition, the clearances in the present model pump may be slightly greater than those in the previous pump since additional precautions were necessary during fabrications to prevent the impeller from rubbing the pump face.

Efficiency

1. Since the efficiency is a function of the head and brake horsepower, it is obvious that the aforementioned reasons for deviation will cause the present model pump efficiency to deviate from previous model pump levels.

These deviations in BHP, Head, and Efficiency will probably be reduced by eliminating some of the problems mentioned. It is anticipated that some deviation (due to roughness and excessive clearance) will not be eliminated. This should not cause any concern, however, since all the comparisons will be made on the same model pump with no reference to previous studies.

Future experimental work will involve air injection. At this time air has been introduced only to determine if the injection system functions properly and to obtain experience in operation. However, it has become obvious that control of the total flow rate (air and water) should be done with a valve in the discharge line in order to obtain controlled total flow rate. It has been observed that when the discharge valve is fully open the total flow rate is in excess of 1600 GPM and intermittent cavitation is observed at the suction line entrance. It is suggested that this problem be discussed further in a meeting with the U. S. Army Corps of Engineers and Lehigh University's representatives.

In conjunction with the above suggestions to test with a discharge control valve the following performance curve presentation is proposed:

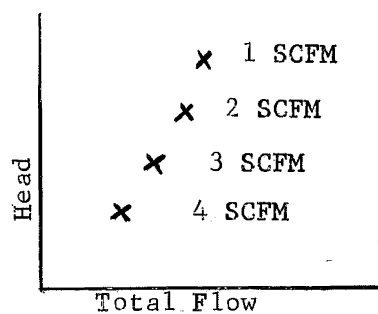


Figure a

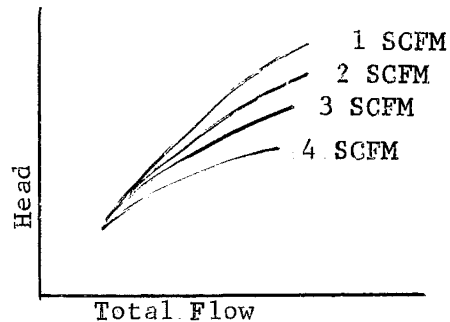


Figure b

As now specified in the contract the total flow (water and air) is to be varied by means of orifices at the entrance to the suction line. For each flow rate as established by an orifice the air content is to be varied from zero to maximum. This would result in a curve similar to Figure a, which shows a decreasing head and decreasing total flow rate (water and air) when the pump flow rate is not changed while increasing the air injection rate. If the test were run with one orifice and the pump discharge was held constant while increasing the amount of air injected then a curve similar to Figure b could be obtained and experimental testing time could be reduced while the final result would be the same.

2. The loss coefficient for the suction line with no orifice in place has been determined to be 0.60. This is much higher than the value for the prototype drag head of 0.30. It is anticipated that with an orifice mounted in the suction line the loss coefficient will be much higher.
3. The dredging depth has been held constant at 94 inches during the preliminary testing. This represents an average figure of the dredging depths submitted to the contractor by letter dated 21 January 1959.

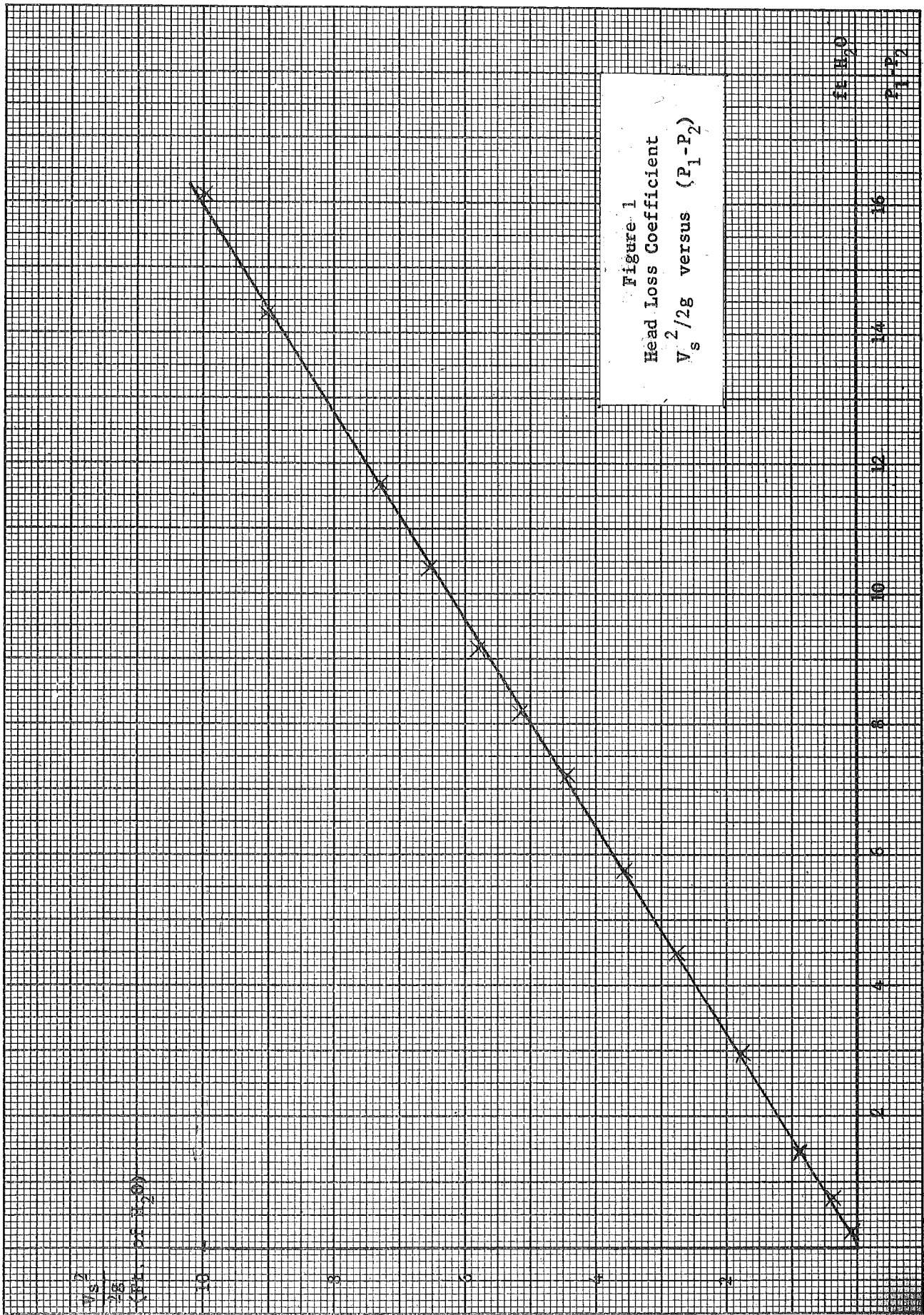
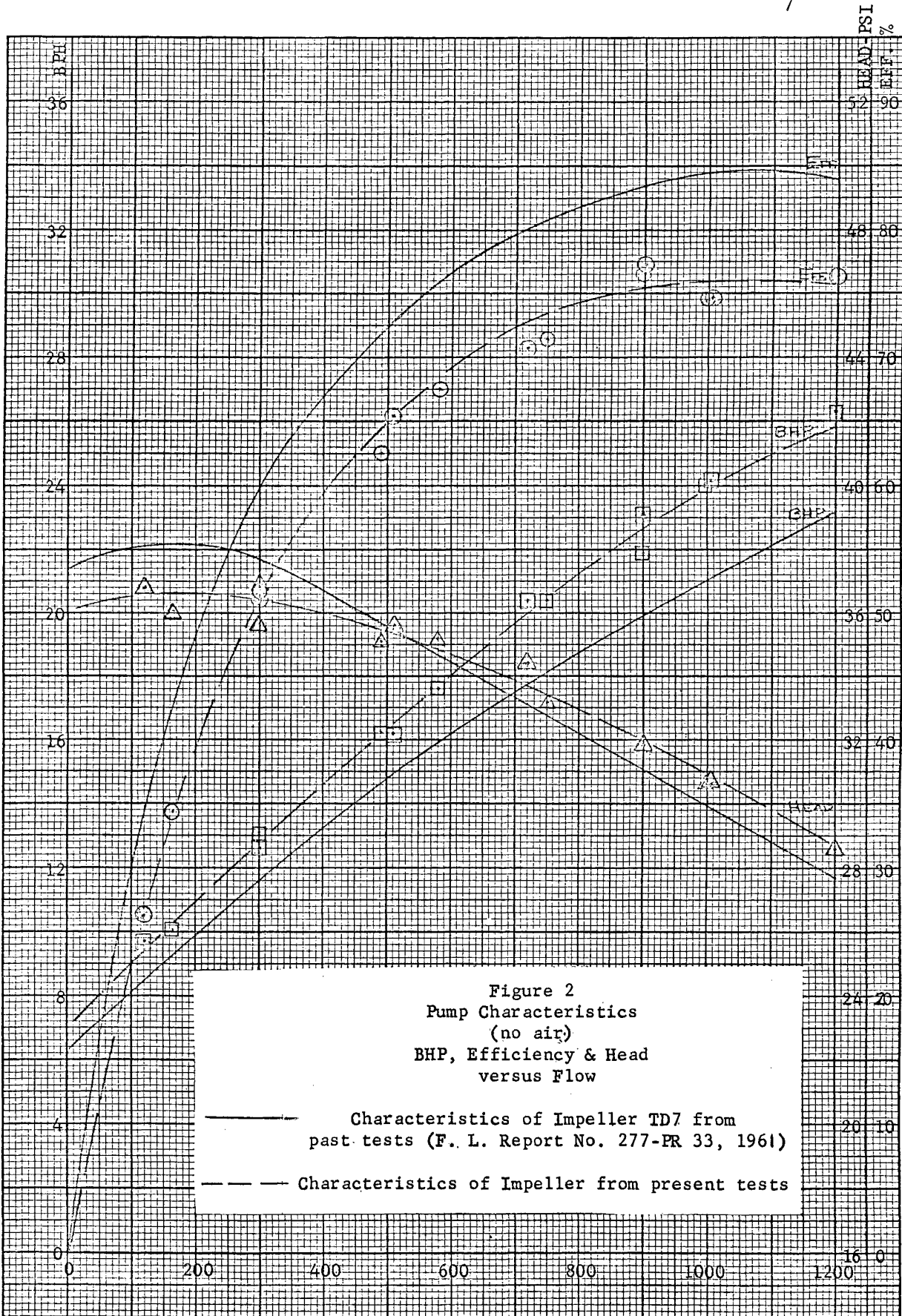


Figure 1
Head Loss Coefficient
 $V_s^2/2g$ versus $(P_1 - P_2)$

$V_s^2/2g$
(ft H₂O)

ft H₂O
 $P_1 - P_2$

K&E 20 X 20 TO THE INCH 359-10 1/2 G KEUFFEL & ESSER CO. MADE IN U.S.A.



FLOW GPM

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