Status report of research project on checking design of a dredge pump, November 1960

J. B. Herbich

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FRITZ ENGINEERING LABORATORY
HYDRAULICS DIVISION
MEMORANDUM No. M-18
F.L. Report No. 283-M-18

STATUS REPORT OF RESEARCH PROJECT
ON
CHECKING DESIGN OF A DREDGE PUMP

Prepared by
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Prepared for
NATIONAL BULK CARRIERS, INC.
New York 17, New York

November 1960
Bethlehem, Pennsylvania
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STATUS REPORT OF RESEARCH PROJECT
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I. INTRODUCTION

The following report summarizes the studies performed during the period July 1 - November 30, 1960, at the Hydraulics Division of Fritz Engineering Laboratory for the Marine Design Division of the National Bulk Carriers, Inc. The project was authorized in a letter from the National Bulk Carriers, Inc., dated June 17, 1960, and signed by Mr. F. J. Joyce, Manager of the Marine Design Division.

II. EXPERIMENTAL STUDIES
A. General Comments

The purpose of the study was to determine the characteristics of a model dredge pump similar to the pump installed on S.S. ZULIA, with one concentration of silt-clay-water mixtures. The preliminary tests were performed with silt-clay-water mixture concentration of 1170 grams per liter and sufficient data obtained to calculate the head-flow, brake horsepower-flow, and efficiency-flow curves for eight impeller speeds. The following model speeds were selected:
1150 revolutions per minute
1300 revolutions per minute
1450 revolutions per minute
1550 revolutions per minute
1650 revolutions per minute
1750 revolutions per minute
1840 revolutions per minute
1900 revolutions per minute

The speed of 1840 rpm in the model corresponds to
prototype speed of 230 rpm.

The impeller was delivered to the laboratory on
September 14, 1960, and the majority of tests were per-
formed during September and October 1960.

B. Model Scale

Similitude requirements for a pump follow those
developed for a closed-conduit flow. Modern pump test-
ing is carried out at prototype velocities and heads.

The similitude relationships between the model
and prototype are as follows:

\[
\frac{N_m}{N_p} = \frac{D_p}{D_m}
\]

where

- \(N\) = speed of pump
- \(D\) = diameter of impeller

and subscripts \(m\) and \(p\) refer to the model
and prototype respectively

\[
\frac{Q_m}{Q_p} = \left(\frac{D_m}{D_p}\right)^2
\]

where

\(Q\) = rate of flow
C. Test Facility

The test loop for pumping the river silt-clay-water mixture consists of a large tank and a centrifugal pump operated by a calibrated Direct Current Motor. Figure A-1 presents a general view of test facility, and for detailed description the reader is referred to Project Report No. 31(1).

III. EXPERIMENTAL RESULTS

Complete pump performance characteristics were plotted for all runs taken; however, the results should be considered preliminary, subject to additional check tests. The preliminary data are presented in Fig. A-2 to A-9. In addition, a plot in prototype dimensions rather than model dimensions, was prepared and is shown in Fig. A-10. Also, a plot of efficiency as a function of rpm for various rates of flow is presented in Fig. A-11.

After completion of tests described above, it was discovered that noticeable wear was evident on the volute casing, particularly around the circumference of the flanges adjacent to the shrouds of the impeller, which increased the model clearances desired. The volute casing was sent for repairs, and it is hoped to have the pump in operation again by December 20, 1960.

* These numerals refer to the list of REFERENCES
REFERENCES

1. Herbich, John B. CHARACTERISTICS OF A MODEL DREDGE PUMP. Fritz Engineering Laboratory, Hydraulics Division Project Report No. 31, September 1959
APPENDIX

Figures A-1 - A-11
FIG: A-3  \( N_R = 1150 \) rpm

![Graph showing performance characteristics](image-url)

- **BHP** (Brake Horse Power) on the vertical axis.
- **Flow GPM** (Gallons Per Minute) on the horizontal axis.
- **HEAD-PSI** on the right vertical axis.
- **Efficiency (EFF)** indicated by various symbols at different flow rates.

The graph illustrates the performance of a machine or system under specified conditions, with key performance indicators such as brake horsepower and flow rate. The data points and trend lines provide insights into how the system behaves across different operating conditions.
FIG. A-4  \( n_1 = 1440 \) rpm

- BHP
- EFP
- Efficiency

Flow GPM
FIG. 4-8  \( n = 1800 \) rpm
FIG. A-8  \( N_m = 1840 \text{ rpm} \)
FIG. A-9 \( N_m = 1900 \text{ rpm} \)