1966

Gas removal systems associated with dredge pump: Phase C

R. E. Miller

S. C. Ko

LEHIGH UNIVERSITY INSTITUTE OF RESEARCH

LEHIGH UNIVERSITY

Centennial Anniversary 1965-66

GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE C

Status Report No. 14

Prepared by
Robert E. Miller
Stephen C. Ko
and
John B. Herbich

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

December , 1966

Bethlehem, Pennsylvania

Fritz Engineering Laboratory Report No. 310.18

CIVIL ENGINEERING DEPARTMENT
FRITZ ENGINEERING LABORATORY
HYDRAULIC AND SANITARY ENGINEERING DIVISION

GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE C

Status Report No. 14

Prepared by

Robert E. Miller

Stephen C. Ko

and

John B. Herbich

Prepared for

U. S. Army Engineers District, Philadelphia

Corps of Engineers

Philadelphia, Pennsylvania

Contract No. DA-36-109-CIVENG-64-72

December 1966

Bethlehem, Pennsylvania

Fritz Engineering Laboratory Report No. 310.18

PREFACE

The following status report summarizes the progress made under Phase C of the project during the period October 1, 1966 to November 30, 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 thirteen status reports dated February 1964, April 1964, October 1964, December 1964, January 1965, June 1965, August 1965, October 1965, December 1965, February 1966, June 1966, August 1966 and October 1966. (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), No. 310.11(11), No. 310.13(13), No. 310.14(14), No. 310.15(15), No. 310.16(16). In addition, a translation (Fritz Engineering Laboratory Report No. 310.17) was prepared of an article entitled, "Wear Phenomena in Centrifugal Dredge Pumps" by A. Welte.

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. He is assisted by Mr. S. Ko and Mr. R. Miller, Research Assistants. Dr. L. S. Beedle is Acting Chairman of the Department of Civil Engineering.

---

* Numbers in parenthesis refer to references on pages 10 and 11.

TABLE OF CONTENTS

I. Experimental Investigation

In the August 1966 status report [15], it was reported that a faulty tachometer generator had necessitated rerunning some of the tests of test series No. 1. The data from these tests have now been processed and several plots are included in this report. The same parameters were used in preparing the graphs as in graphs enclosed in the June 1966 status report [14]. The general shape of all curves remains the same but those enclosed herein are to be considered more accurate.

Specific Comments on Curves

The point where the water discharge drops off because of high air content is very unstable. As a result the data in this narrow range are difficult to reproduce. The points before and after the drop off point are reasonably well defined and can be easily reproduced.

The water discharge as a function of air volume curves (Fig. 3) were plotted primarily to record the collapse point. Please note that no zero is plotted on the water discharge axis. This was done to keep the detail over the useful flow range. This means the points plotted directly on the abscissa are the collapse points where water discharge is zero. Putting a vertical tangent at these points somewhat distorts the shape of the lower part of the curve. However, no intermediate points can be obtained due to the instability of the collapsing pump. Therefore, this part of the curve should be considered purely qualitative.

The results of two tests run at pump speeds other than 1440 rpm are also included (Figs. 4 & 5). The 1300 rpm curve agrees very well with the 1440 rpm curve. The 1600 rpm curve has a fairly large deviation at low flow rates. It was concluded that pump speed is not a significant variable within the non-cavitation flow ranges and it is planned to conduct all future tests at 1440 rpm.

The results of the tests run as a geometry check were quite satisfactory. The reason for this test was to determine whether placing of this accumulator in the suction line affected the pump performance. The results of four tests conducted plotted very closely to the curves in Figure 1. This indicates that the geometry changes caused by the addition of the accumulator do not significantly affect the pump performance. It will be therefore possible to use the results of past tests without the accumulator as a comparison for future tests with the accumulator.

II. Progress on Installation

The laminar flow air meter was installed in the vacuum line. A resistance type temperature sensor and a vacuum gage were installed at the flowmeter entrance so that corrections to standard temperature and pressure could be made. It was discovered during the first test that water as well as air was evacuated from the accumulator. Since it is highly undesirable to have water in either the flowmeter or the vacuum pump, a nine foot standpipe was installed before the vacuum pump. This proved inadequate and water still found its way into the vacuum pump. It was tried on numerous occasions to regulate the vacuum pressure so that only gas will be pulled from the accumulator, but as soon as the vacuum line has a pressure lower than the accumulator, water flows toward the vacuum pump.

It has been decided to raise the standpipe to thirty-four feet above the accumulator. This should prevent water from entering the vacuum pump unless an air-water pumping action is occurring. If this pumping action occurs it will be necessary to install a separator in this line.

The level-trol has been tried several times and is operative. However, some difficulties were encountered in getting the proper adjustment of the reset, proportional band, and level controls on the level-trol. As a result, the response time of the instrument is not rapid enough to keep a constant level in the accumulator.

III. Experimental Data - Test Series I

1. **Figure 1** **Dimensionless** Head as a function of **Dimensionless** Discharge. Air content 0 - 10%.

2. **Figure 2** **Water Discharge** as a function of **Air Percentage.**

3. **Figure 3** **Water Discharge** as a function of **Air Volume.**

4. **Figure 4** **Dimensionless Head** as a function of **Dimensionless Discharge.** Model speed 1300 rpm.

5. **Figure 5** **Dimensionless Head** as a function of **Dimensionless Discharge.** Model speed 1600 rpm.

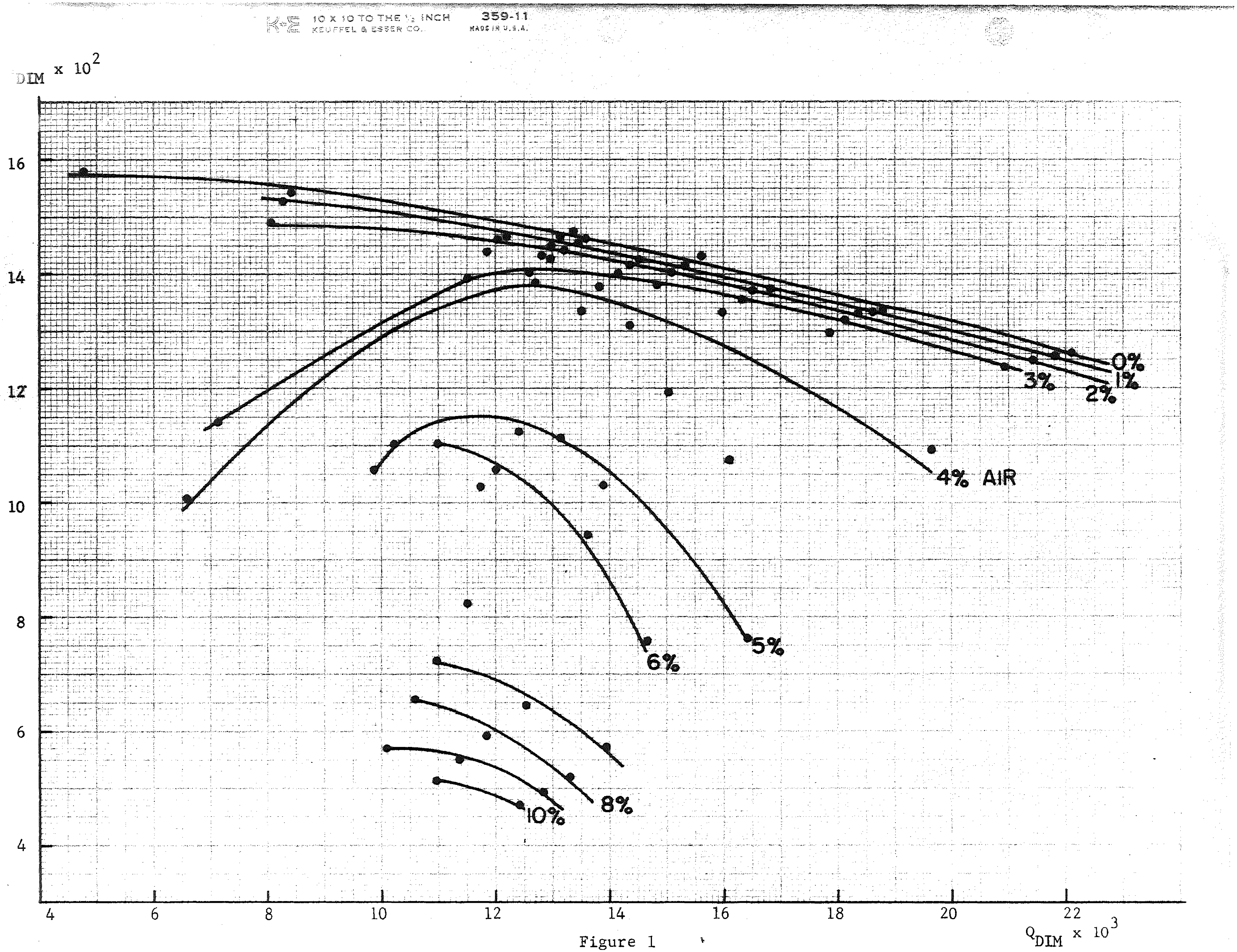
10 X 10 TO THE ½ INCH
KEUFFEL & ESSER CO.
359-11
MADE IN U.S.A.
DIM x 10^2
16
14
12
10
8
6
4
4
6
8
10
12
14
16
18
20
22
Q DIM x 10^3
0%
1%
2%
3%
4% AIR
5%
6%
8%
10%

Figure 1

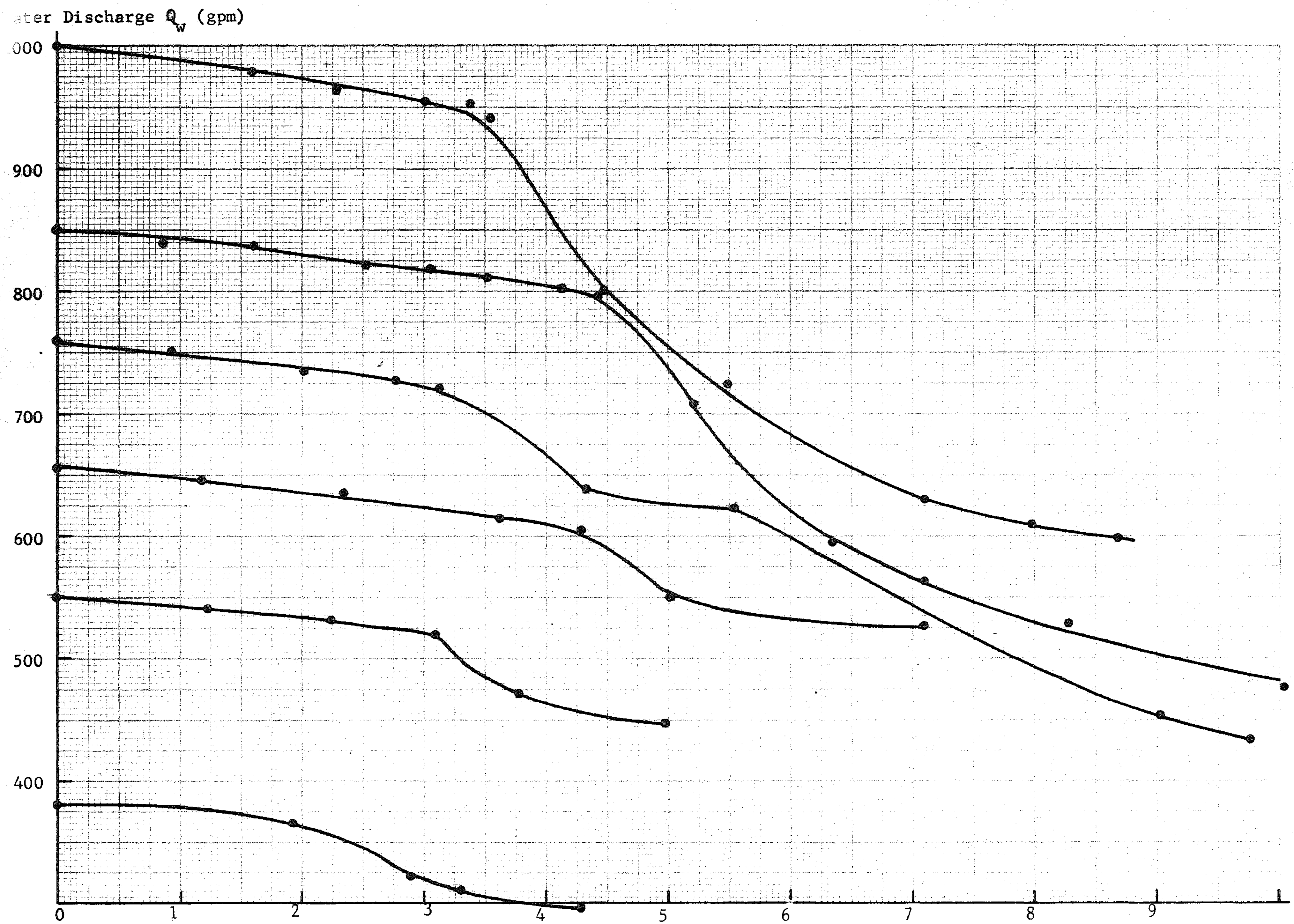

Figure 2 Air Percentage (% of water discharge)

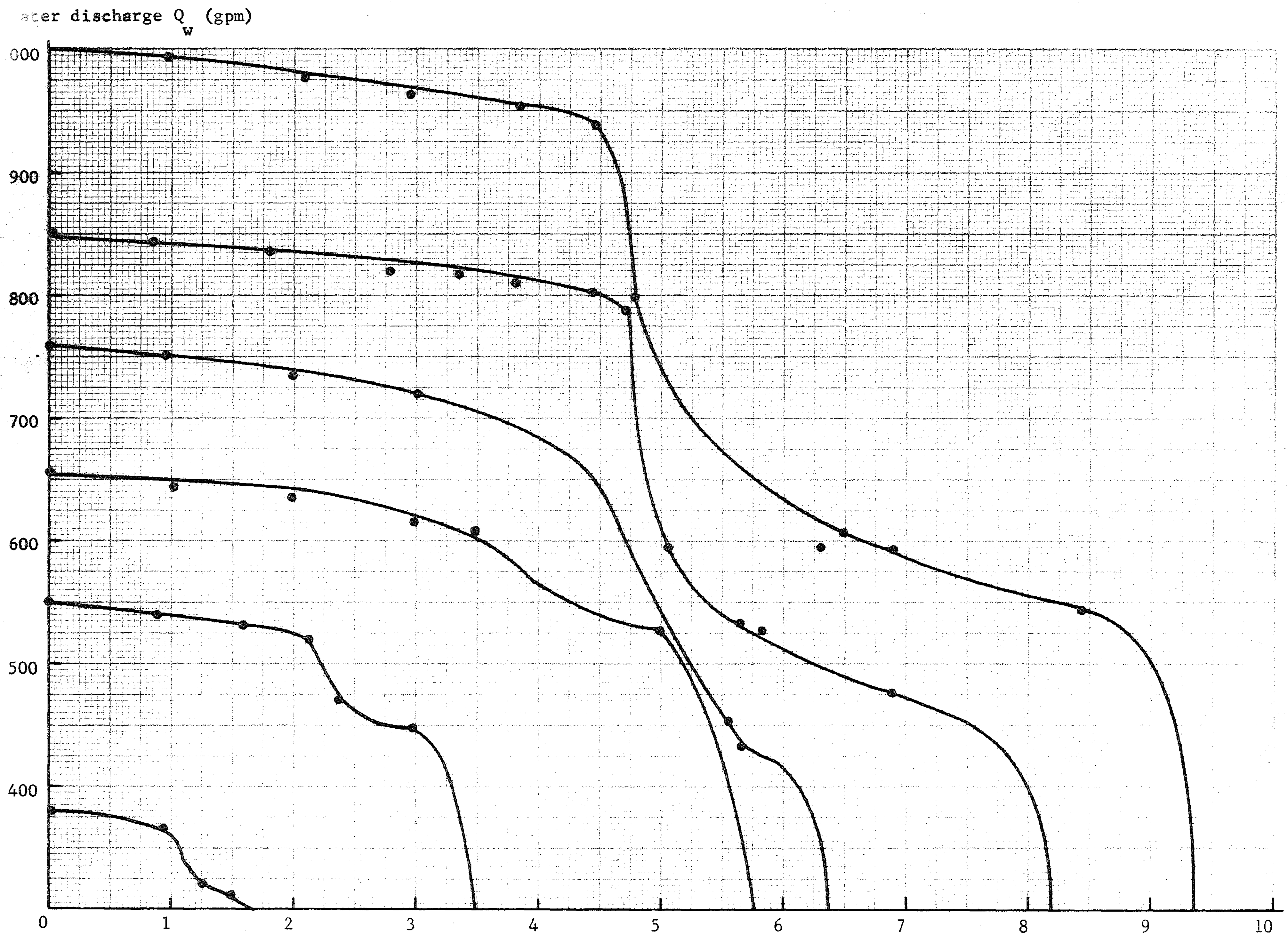
ater discharge Q_w (gpm)
000
900
800
700
600
500
400
0
1
2
3
4
5
6
7
8
9
10
Air Volume (SCFM)

Figure 3

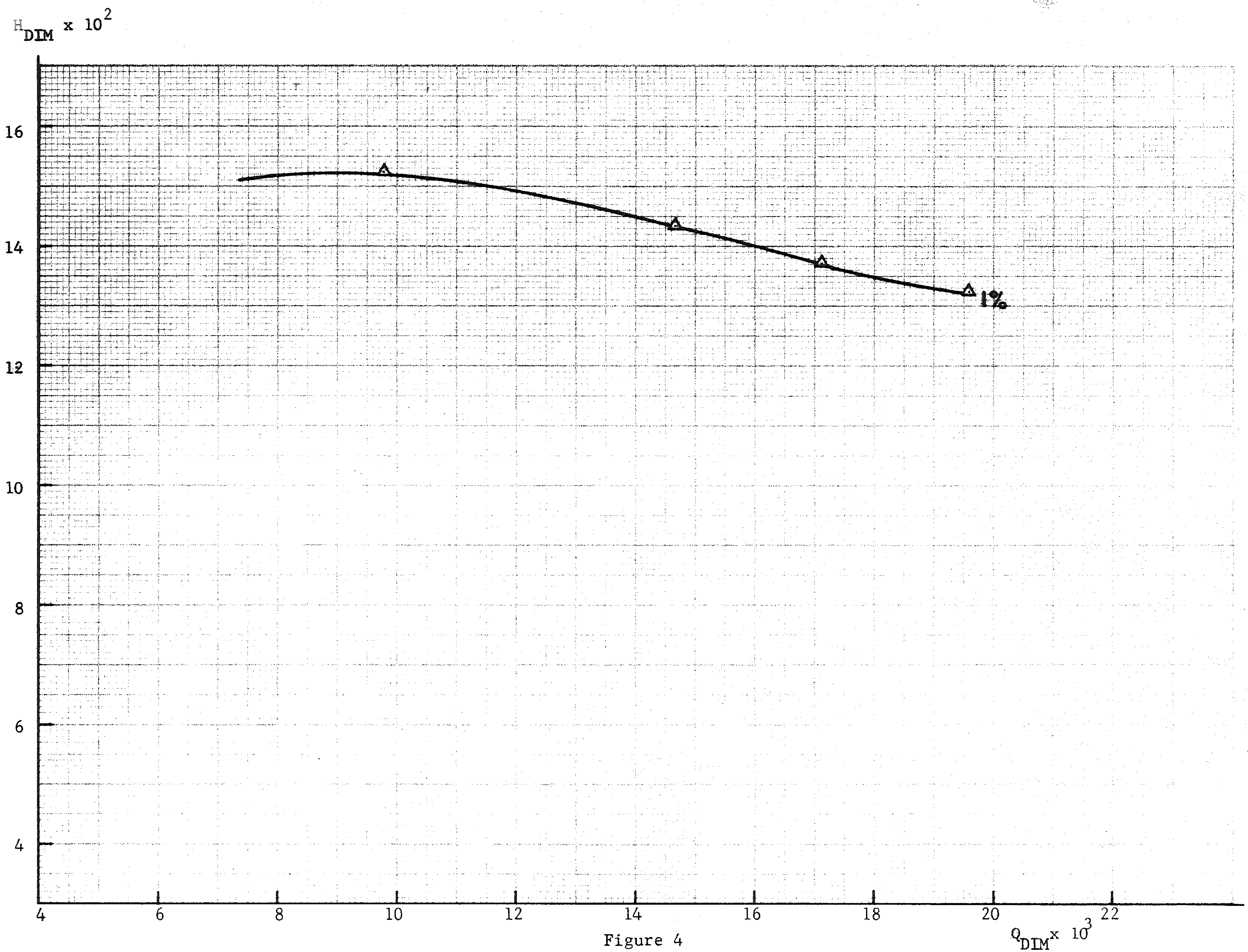

Figure 4

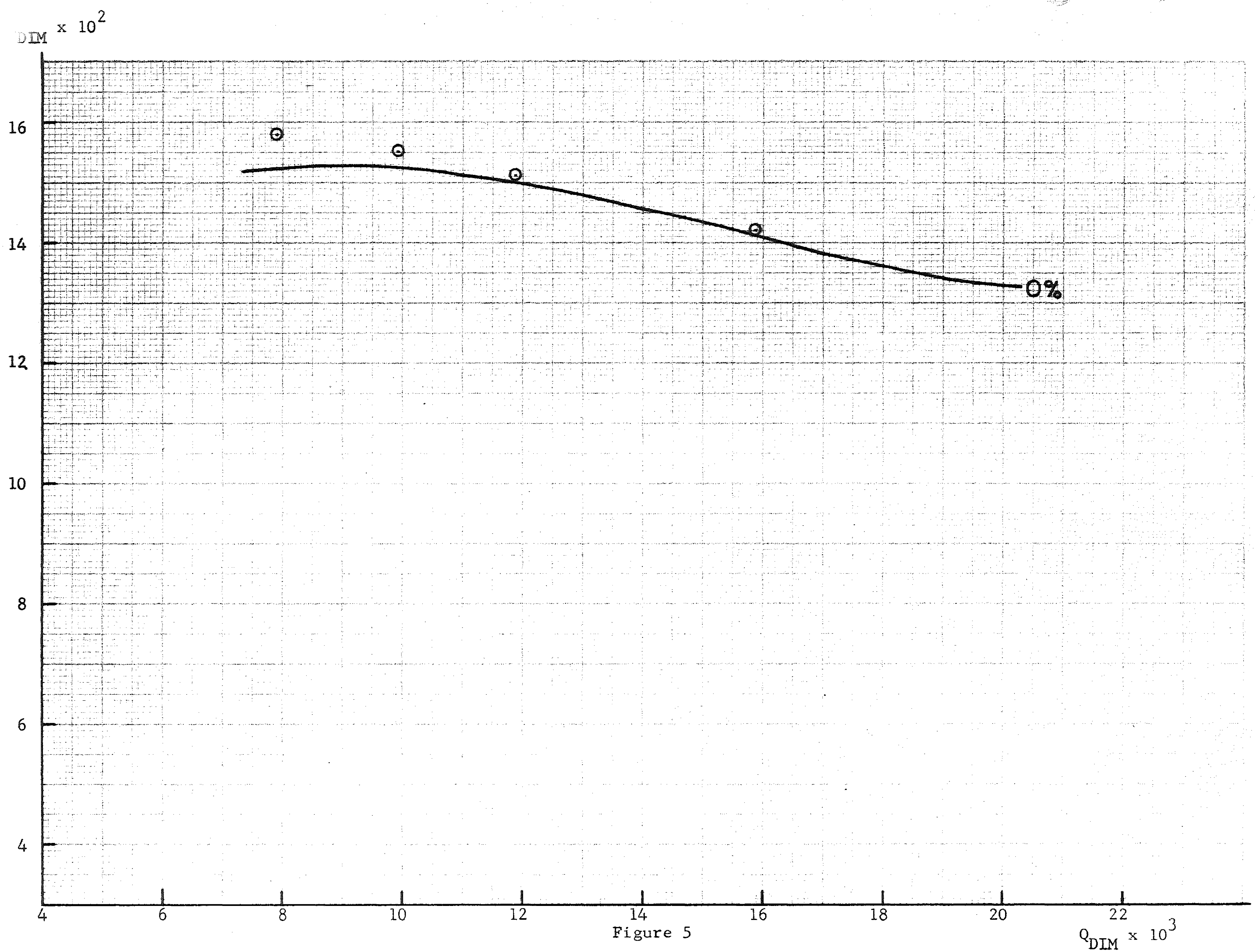

Figure 5

REFERENCES

(1) Herbich, J. B.
GAS REMOVAL SYSTEMS ASSOCIATED WITH DREDGE PUMPS, Lehigh University, Fritz Engineering Laboratory Report No. 310.1, February, 1964.

(2) Vesilind, P. A. and Herbich, J. B.
GAS REMOVAL SYSTEMS ASSOCIATED WITH DREDGE PUMPS, Lehigh University, Fritz Engineering Laboratory Report No. 310.2, April, 1964.

(3) Herbich, J. B.
GAS REMOVAL SYSTEMS ASSOCIATED WITH DREDGE PUMPS: PHASE B, Lehigh University, Fritz Engineering Laboratory Report No. 310.4, October, 1964.

(4) Shindala, A., Herbich, J. B., Amatangelo, A., and Bagge, G.
GAS REMOVAL SYSTEM PHASE B: PART I, FORMULATION OF TEST PROGRAM, Lehigh University, Fritz Engineering Laboratory Report No. 310.5, December, 1964.

(5) Shindala, A., Herbich, J. B., Amatangelo, A., and Bagge, G.
GAS REMOVAL SYSTEM PHASE B: PART I, FORMULATION OF TEST PROFRAM, Lehigh University, Fritz Engineering Laboratory Report No. 310.6, January, 1965.

(6) Shindala, A. and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B, Lehigh University, Fritz Engineering Laboratory Report No. 310.8, June, 1965.

(7) Amatangelo, A. and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B, Lehigh University, Fritz Engineering Laboratory Report No. 310.9, August, 1965.

(8) Herbich, J. B. and Isaacs, W. P.
GAS REMOVAL SYSTEMS PART I: LITERATURE SURVEY AND FORMUIATION OF TEST PROGRAM, Lehigh University, Fritz Engineering Laboratory Report No. 310.3, June, 1964.

(9) Shindala, A. and Herbich, J. B.
GAS REMOVAL SYSTEM, PART II, FORMULATION OF TEST PROGRAM, DEVELOPMENT OF FACILITY LAYOUT, Lehigh University, Fritz Engineering Laboratory Report No. 310.7, February, 1965.

(10) Amatangelo, A. and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B, Lehigh University, Fritz Engineering Laboratory Report No. 310.10, October, 1965.

(11) Amatangelo, A. and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE B, Lehigh University, Fritz Engineering Laboratory Report No. 310.11, December, 1965.

(12) Herbich, J. B. and Vallentine, H. R.
EFFECT OF IMPELLER DESIGN CHANGES ON CHARACTERISTICS OF A MODEL DREDGE PUMP, Lehigh University, Fritz Engineering Laboratory Report No. 277, September, 1961.

(13) Amatangelo, A., Miller, R. E., and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE C, Lehigh University, Fritz Engineering Laboratory Report No. 310.13, February, 1966.

(14) Basco, D., Bagge, G., Miller, R. E., and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE C, Lehigh University, Fritz Engineering Laboratory Report No. 310.14, June, 1966.

(15) Basco, D., Bagge, G., Miller, R. E., and Herbich, J. B.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE C, Lehigh University, Fritz Engineering Laboratory Report No. 310.15, August, 1966.

(16) Herbich, J. B., and Miller, Robert, E.
GAS REMOVAL SYSTEM ASSOCIATED WITH DREDGE PUMP: PHASE C, Lehigh University, Fritz Engineering Laboratory Report No. 310.16, October, 1966