Influence of the electromagnetic flowmeter on the fluid containing a ferromagnetic substance

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1 Introduction

The electromagnetic flowmeter is widely used when the flow measurement of two-phase fluids, which contain various solid particles in the fluid, encounter problems such as pressure loss and abrasion. However, if the solid particles in the fluid contain magnetic bodies, such as iron, it is difficult to achieve correct measurement from the principle of the electromagnetic flowmeter.

In this study, the pulsed DC excitation electromagnetic flow meter (MagneW) is used, and since the experiment of the measurement error of the quantity of flow of the fluid containing a ferromagnetic substance particle is investigated, it will be reported here.

2 Theoretical background

It is described how the generation of electromotive power is affected when the fluid containing a magnetic substance passes through the inside of the electromagnetic flowmeter. The magnetic flux originally generated with a coil is eternal. Among these, it is thought that it passes through the pipe about halfway. When magnetic substances are mixed here, magnetic resistance decreases. (Therefore the rate of leakage of magnetic flux can be decreased.) To restate, the magnetic flux generated from the coil has in great numbers passed through the inside of the pipe, and naturally the magnetic flux density will also increase. The increase in the magnetic flux density becomes the increase in the generation of electromotive power without even correcting it.

In this experiment, the weight concentration of the ferromagnetic substance was changed, the flow velocity was changed, and the influence was investigated using a 40mm detector and a 100mm detector.

3 Experiment equipment and its method

In this experiment, magnetite was used as a ferromagnetic substance. It includes 68.9% of the magnetic parts, whose true specific gravity is 3.73.

The block diagram of experiment equipment is shown in Fig. 1. Put magnetite and water into the mixing tank and thoroughly mix with the rotary sump. With the

convertible speed motor attachment sand pump, let it flow through the perpendicularly piped electromagnetic flowmeter of 100mm and 40mm. Thoroughly rotate at a state where the liquid density is stabilized in the measurement tank, and the electromagnetic flowmeter output has been checked.

40A electromagnetic flowmeter with pulsed DC excitation

1) Lining: Teflon FEP

2) Electrode: SUS316L

100A electromagnetic flowmeter with pulsed DC excitation

1) Lining: Polyurethane rubber

2) Electrode: SUS316L

The flow quantity was measured by the volumetric method. The measured water calibrated the measurement tank accurately so that the volume can be measured by reading the level of the tank. The counter read the time it takes for the fixed volume to fill and the other counter read the amount added up during that time by the electromagnetic flowmeter.

The specific gravity bottle and the mud balance meter were used for the measurement of the specific gravity. When the mixed fluid becomes low concentration, the magnetite easily separates from water and the concentration easily changes. Measure after a thorough mixing cycle, while confirming specific gravity before and after measurement.

4 Experiment result

The magnetic part content is expressed with the weight concentration of the following formula.

Ps: True specific gravity of a solid particle

Pm: Specific gravity of mixed fluid

Pw: Specific gravity of water

D: Weight concentration

In Fig. 3 the electromagnetic flowmeter indicates the flow and tank measurement flow of 40mm detector, Fig. 4 indicates the same for 100mm detector. Moreover, in Fig. 5 the relation of the amount of signal shifts and magnetite weight concentration of the electromagnetic flowmeter of caliber 40mm is shown.

The following was observed during the experiment.

(1) The zero of this electromagnetic flowmeter was stable until it resulted in magnetite mixed high concentration from water.

(2) Although it was a short period of time, adhesion of a magnetic

substance in the electrode and the lining side of this electromagnetic flowmeter didn't occur at all.

(3) The reproducibility of the electromagnetic flowmeter output to the same concentration was satisfactory.

5 Experiment result consideration

(1) As shown in Fig. 3 and 4, in the case of magnetite with the same concentration, the output of the electromagnetic flowmeter is linear to the actual flow with a flow zero as the starting point.

(2) Although there are fewer observation points of 100mm as compared with Fig. 3 and 4, the amount of shifts to specific gravity is almost the same as that of 40mm and 100mm.

(3) From Fig. 5, the amount of output shift until 20-30% of weight concentration is proportional to that concentration. If the weight concentration exceeds 40%, the amount of output shift will become saturated.

Moreover, although the electromagnetic flowmter was treating the signal at a very low level, in addition to the output shift under the influence of a ferromagnetic substance, there were especially no problems during measurement.

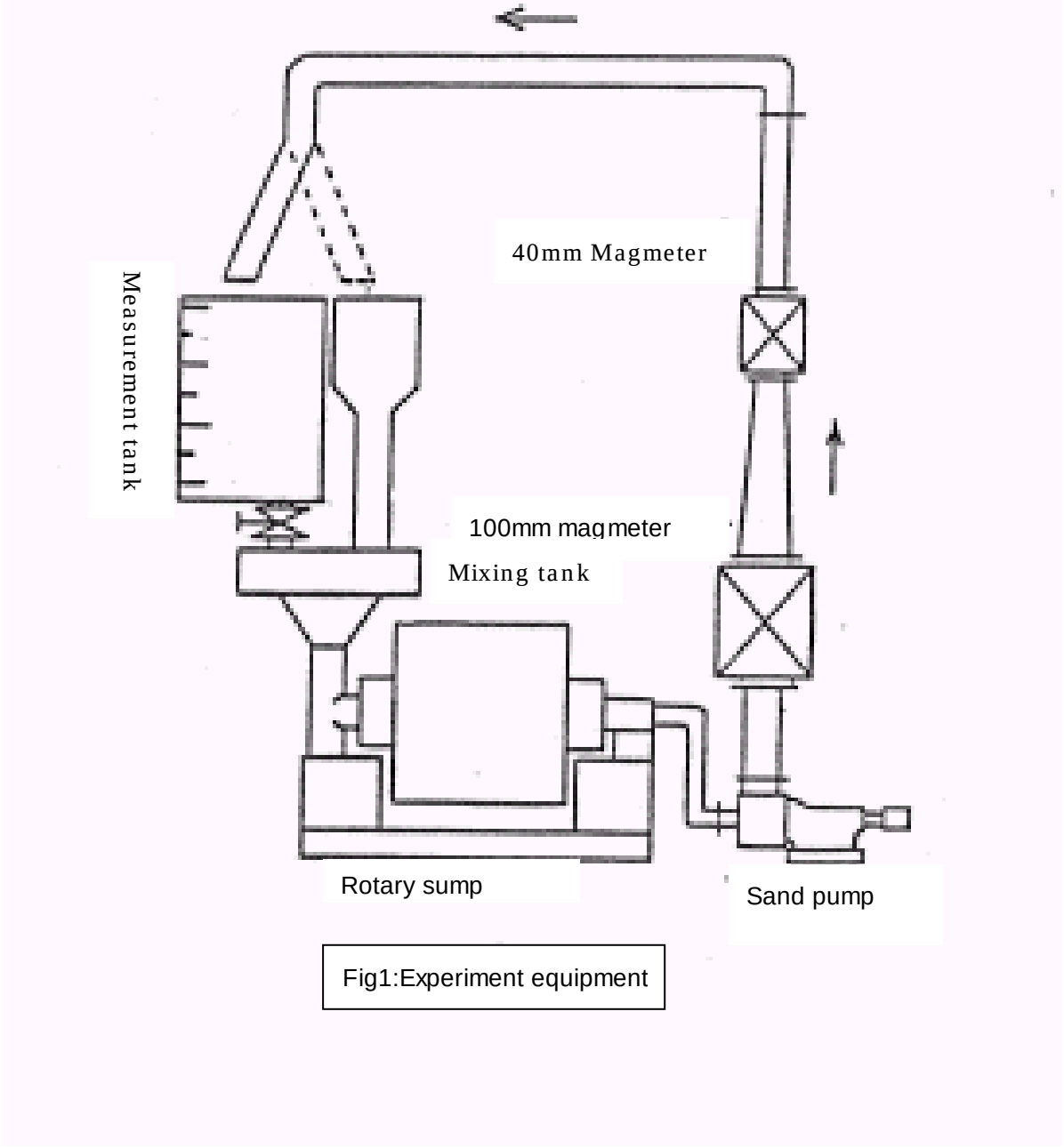

Fig1:Experiment equipment

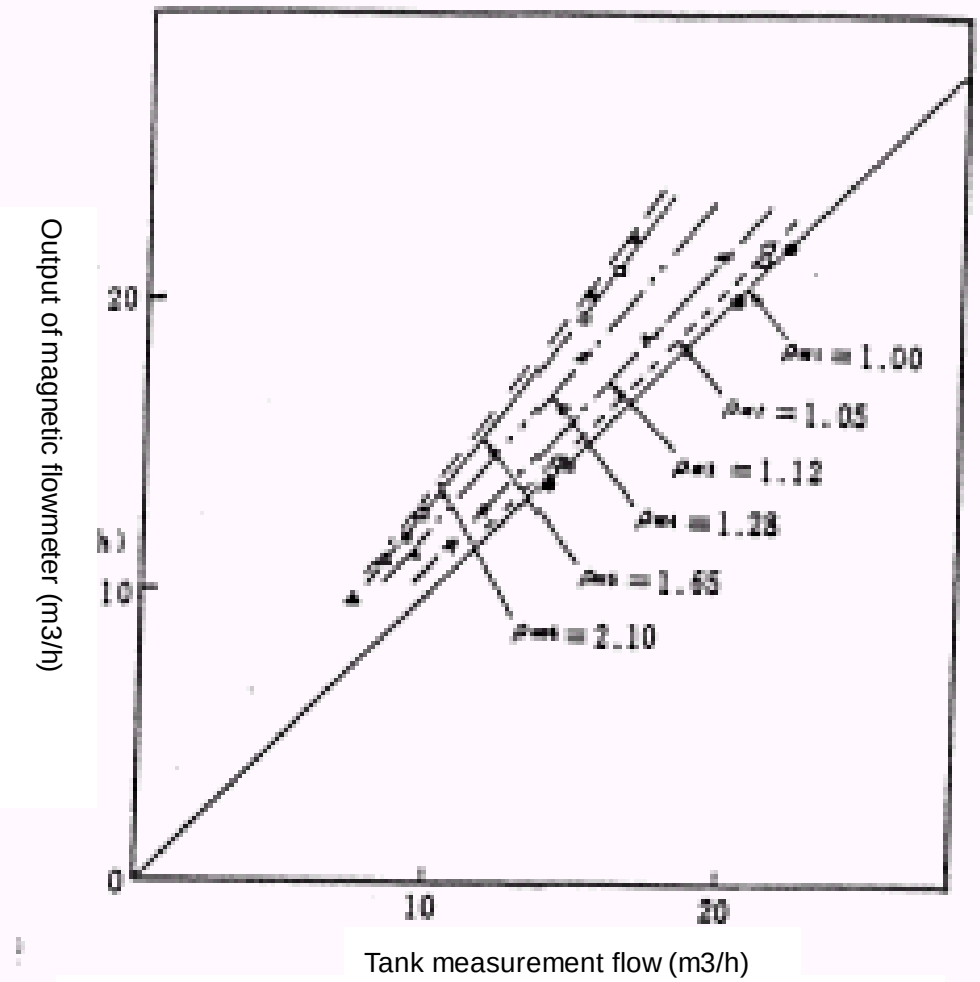

Fig3 Output of magnetic flowmeter(40mm) affected by magnetite

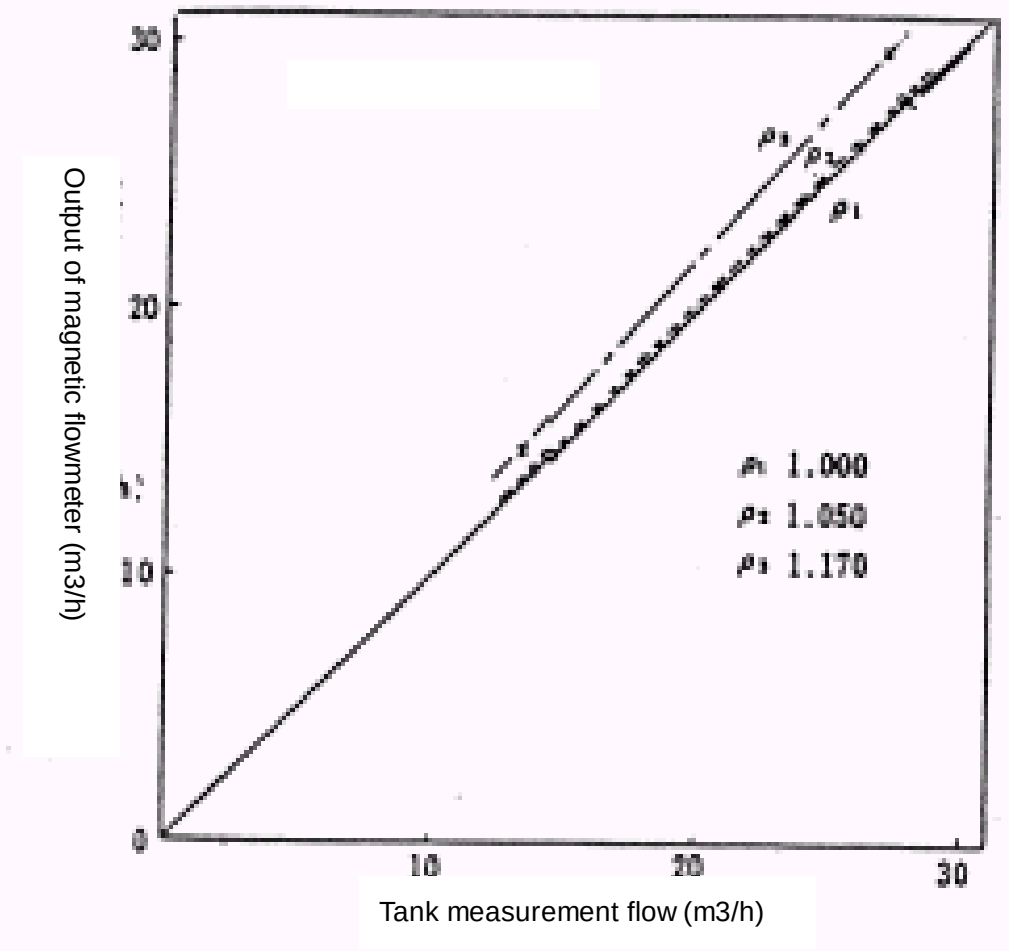

Fig4 Output of magnetic flowmeter(100mm) affected by magnetite

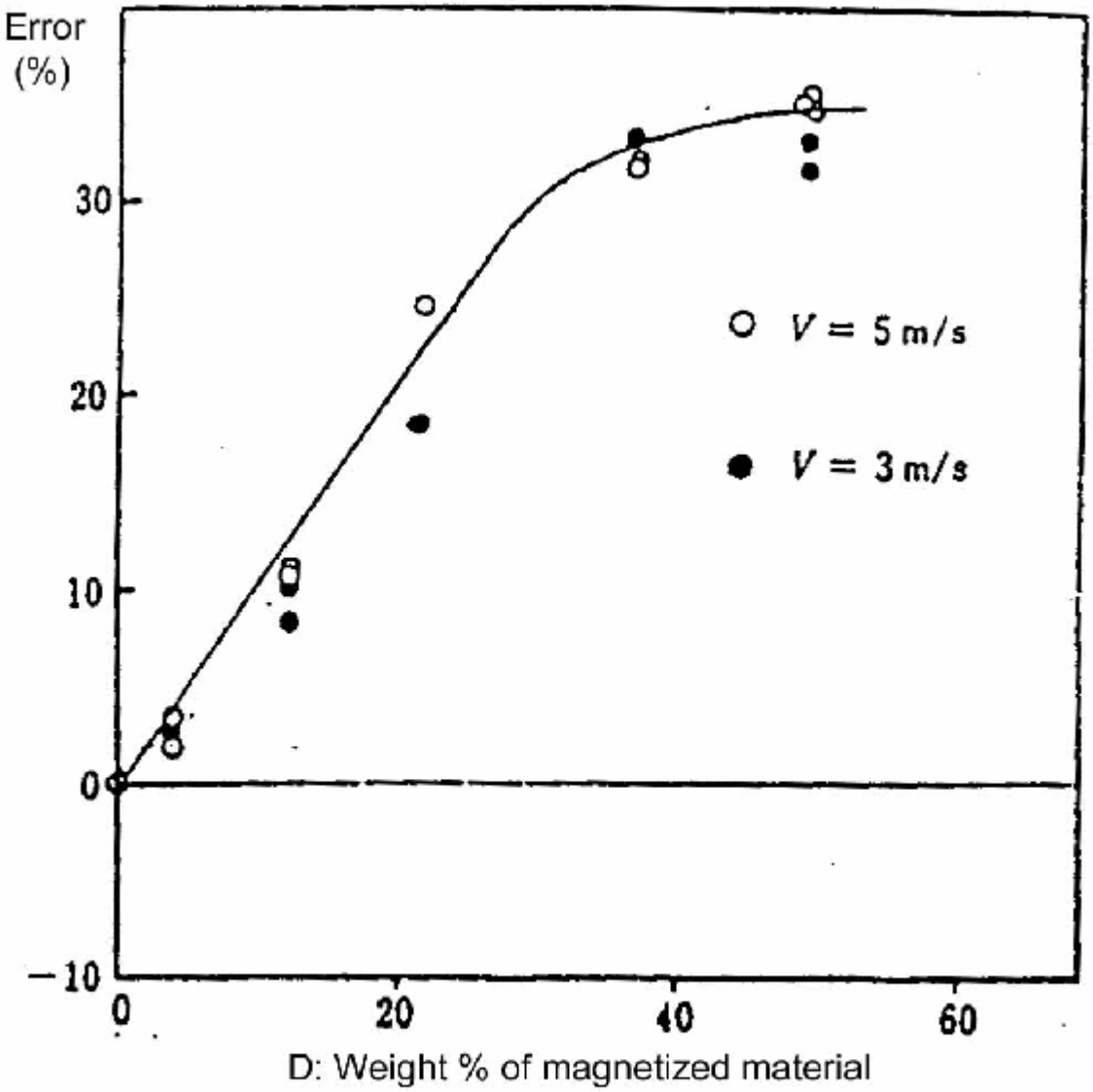

Fig5: Output shift by magnetized material in the flow medium
Size: 40mm NNM type detector