

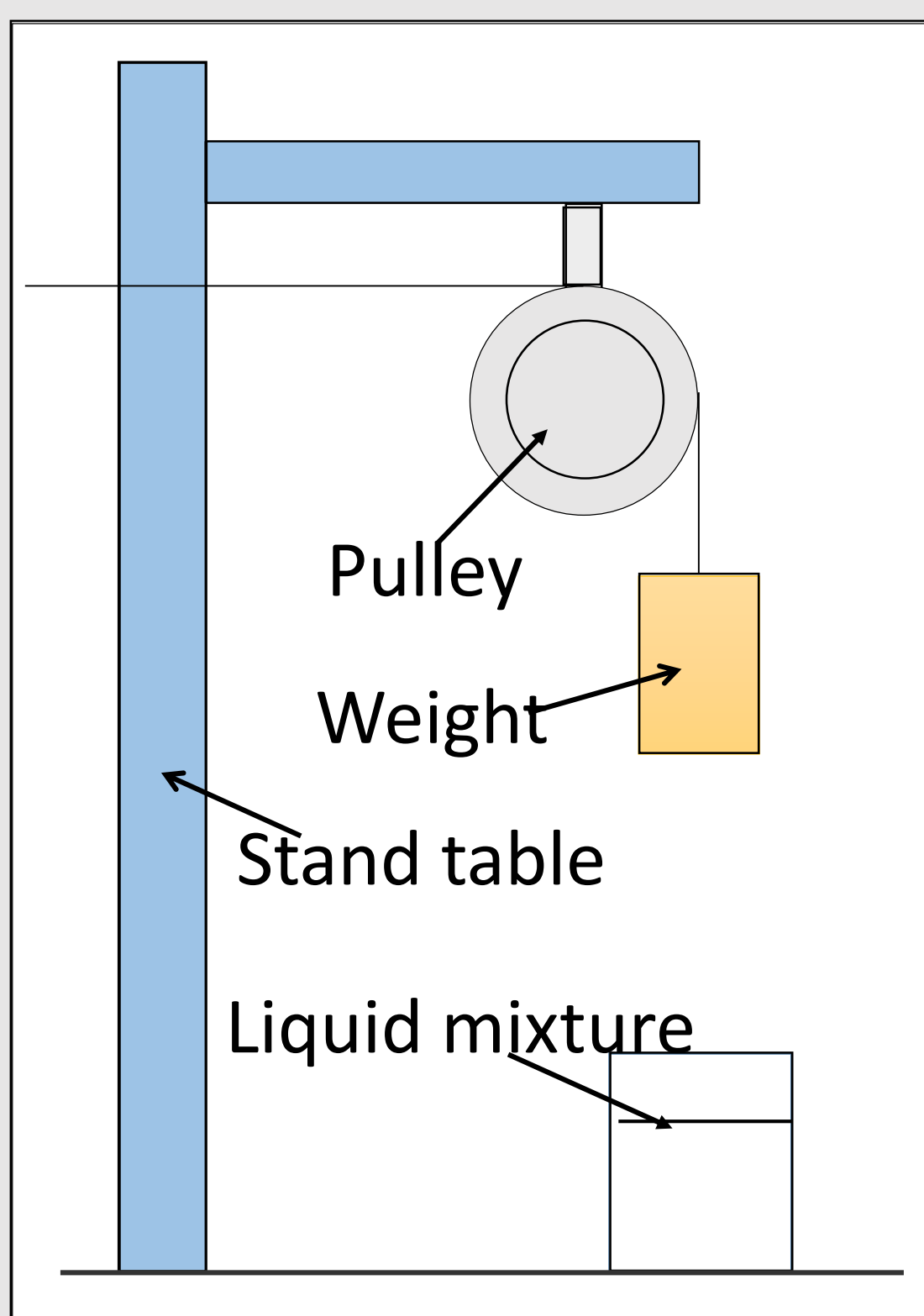
Application of the Dilatancy Phenomenon to Protective Gear

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Introduction

The dilatancy phenomenon is a phenomenon in which what normally shows the properties of a liquid shows the properties of a solid when a force is applied. For example, a mixture of potato starch and water in a specific ratio has this property. We believe that using a liquid that has this phenomenon in protective gear will improve comfort. For this purpose, we investigated the conditions under which the phenomenon can occur.

Experiment 1



Equipment

- Weight
- Stand table
- Liquid mixture (Potato starch and water)
- Pulley

Experimental method

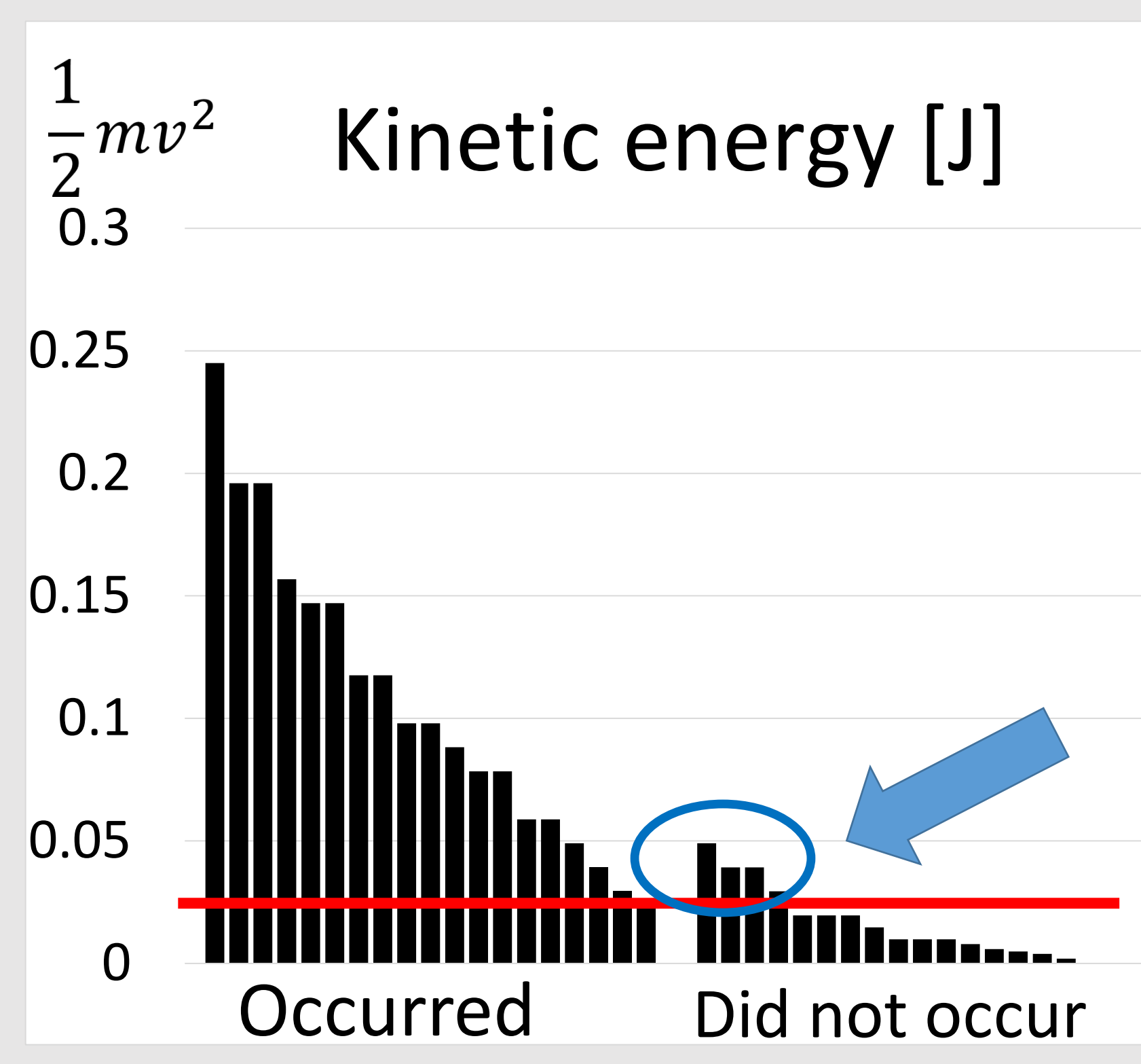
- ① Prepare the weights and camera
- ② Drop the weight in the liquid mixture
- ③ Confirm phenomenon from the recording

(Figure 1)

We varied the weight to 10 g, 20 g, 30 g, 40 g and 50 g, and the height to 2 cm, 5 cm, 10 cm, 20 cm, 30 cm, 40 cm and 50 cm.

The velocity at which the weight hit the mixture was given by $v = \sqrt{2gh}$.

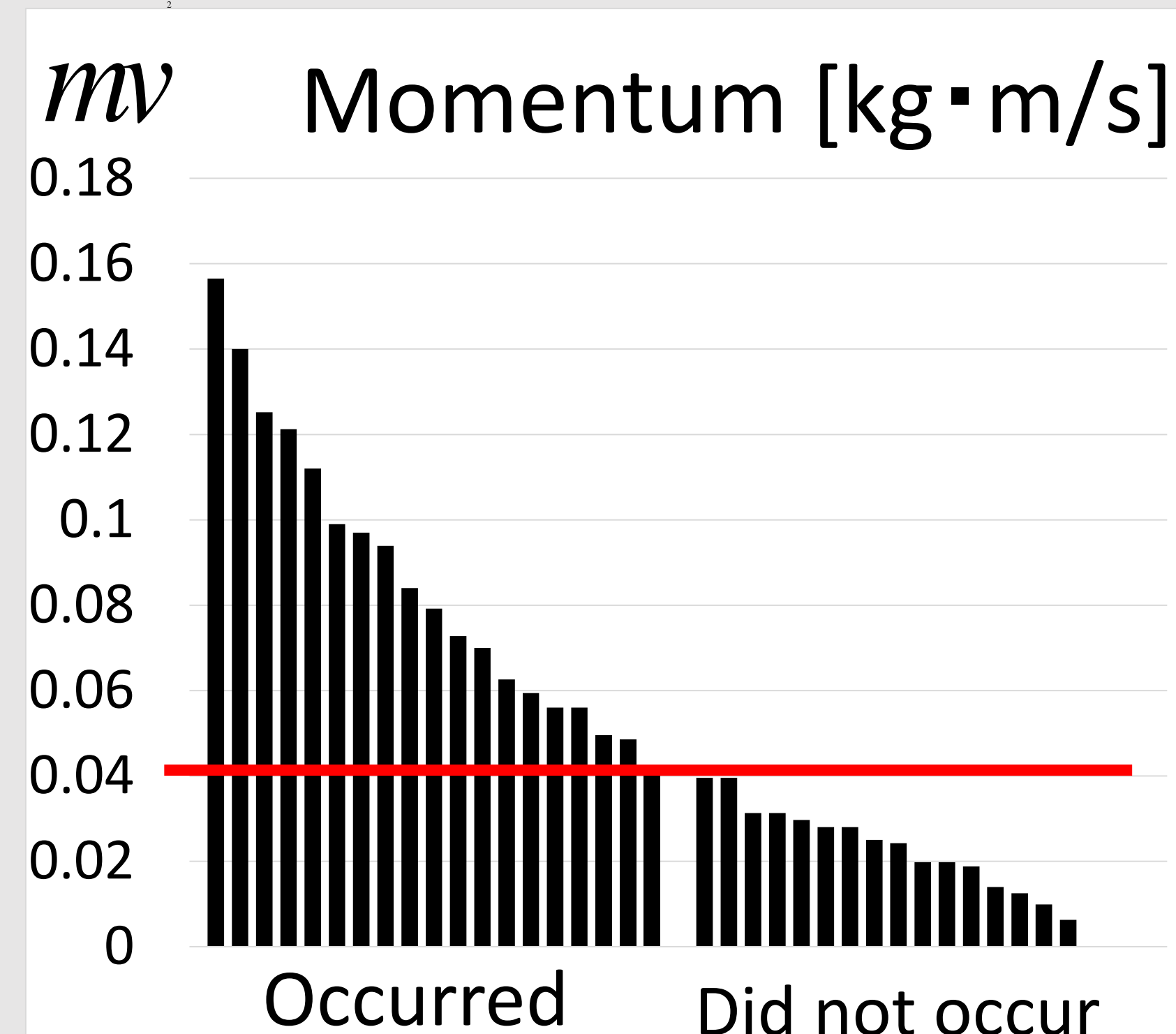
Result 1



(Figure 2)

The vertical axis shows the kinetic energy of the weight ($1/2mv^2$) at the point of impact.

Figure 2 does not show a clear lower limit on kinetic energy.



(Figure 3)

The vertical axis shows the momentum of the weight at the point of impact

$$(p = mv = m\sqrt{2gh}).$$

Figure 3 shows a clear lower limit on momentum at around 0.04 kg·m/s.

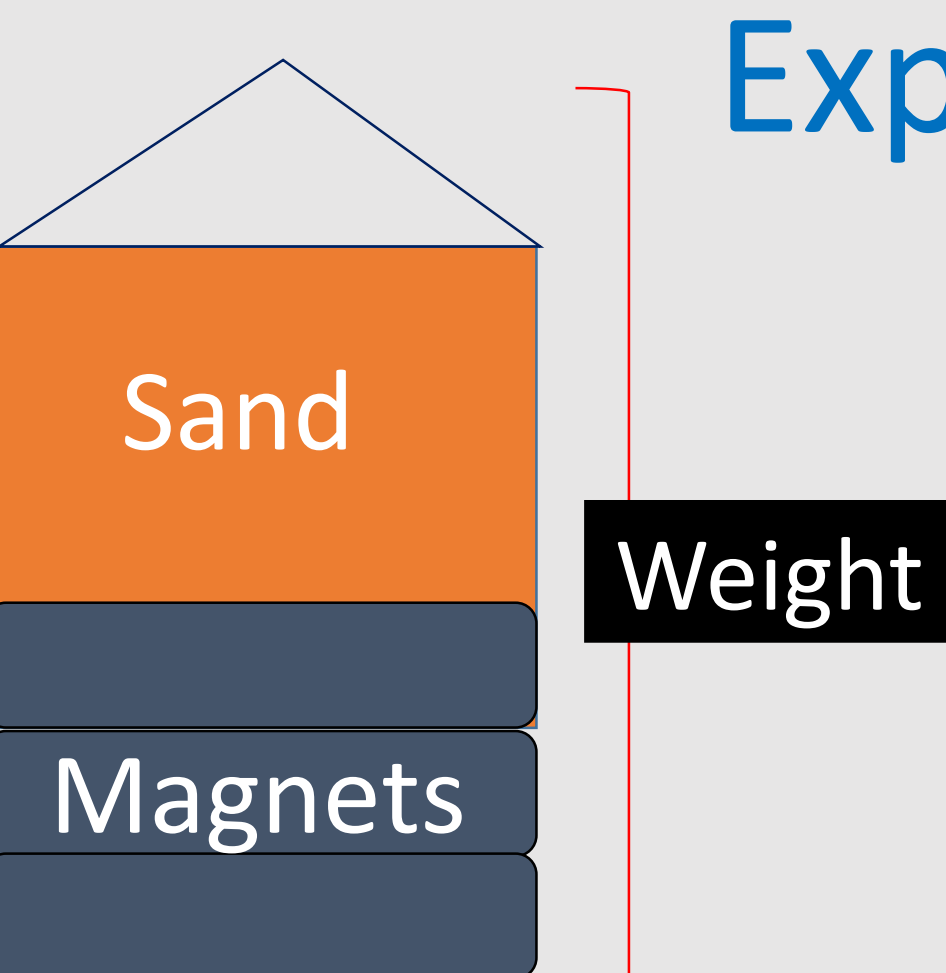
Experiment 2

Experimental method

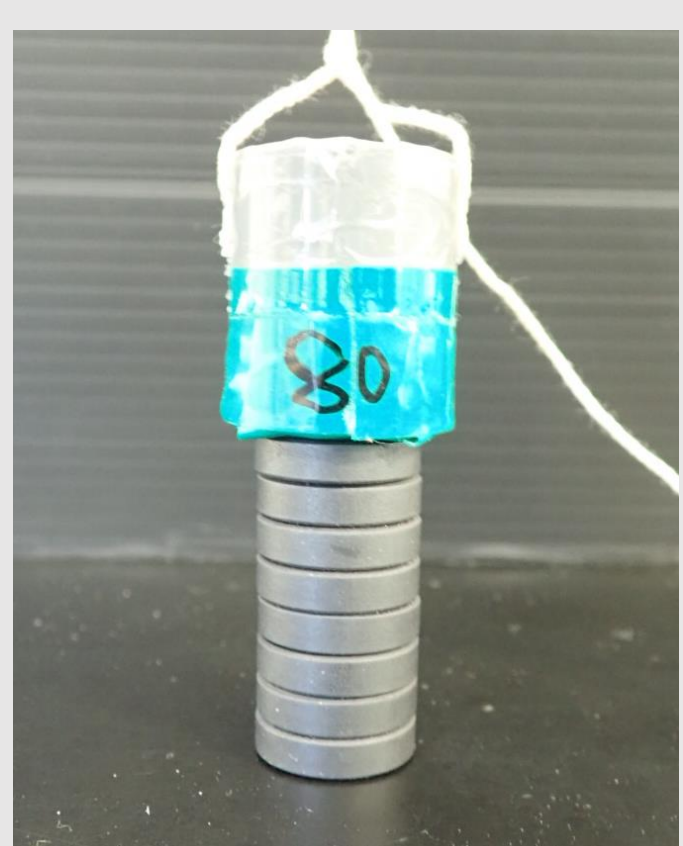
Same as experiment 1

We stabilized the center of gravity.

- ① Use magnets to change the rough mass
- ② Add sand to adjust the precise mass



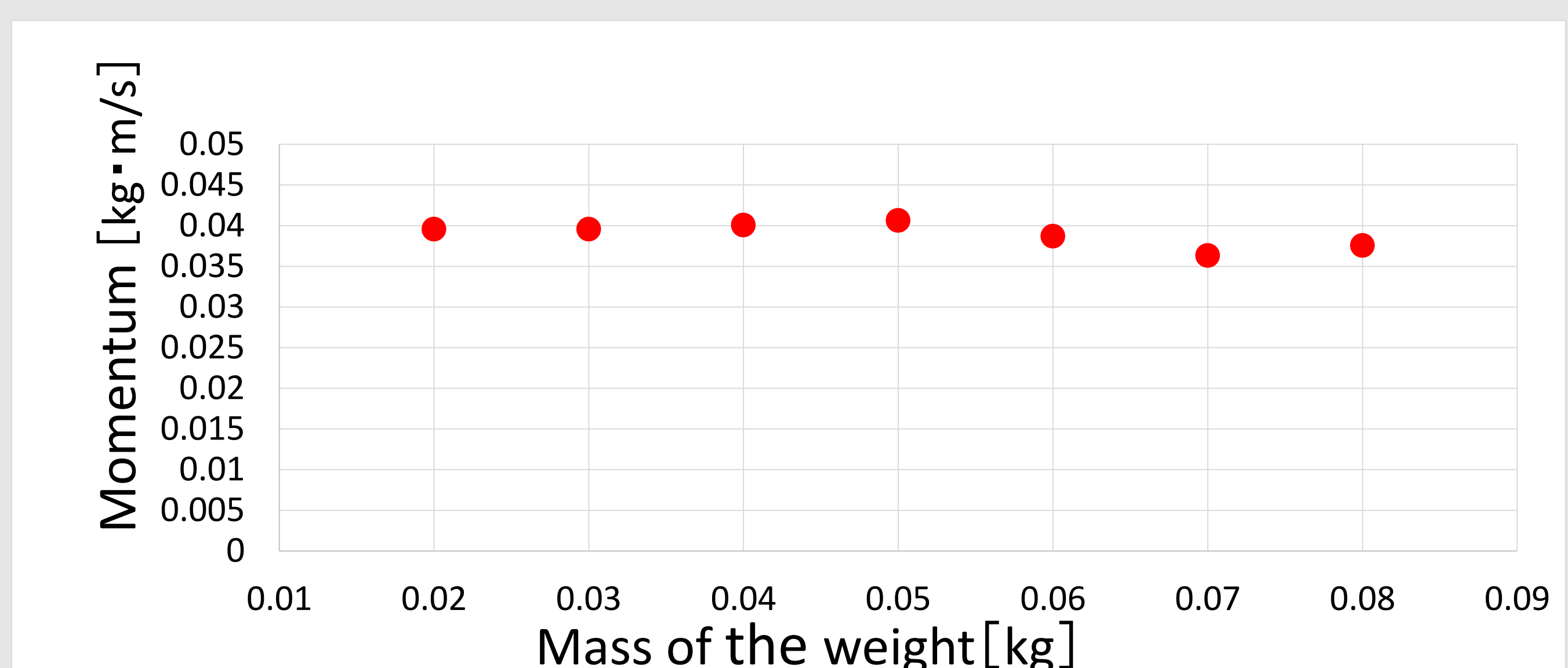
(Figure 4)



Conclusion

The occurrence of the dilatancy phenomenon in this mixture is directly related to the applied momentum.

Result 2 The lower limit on momentum was constant



(Figure 5)

Future Task

What other things are involved in the occurrence of the phenomenon?

Reference

測定から読み解くレオロジーの基礎知識, 日刊工業新聞社, pp. 76-77(2017)