

Faisal Alismail
Team Second Report
MCEN 4151 Flow Visualization
November 11, 2019

Fluidized Bed of Sand

The team second assignment is designed to prompt students to be creative and artistic to develop an experiment that demonstrates a fluid phenomenon. Working in a group with multiple team members, allow us to design our own experiment from the start. Meaning, we get the opportunity to build the setup, control variables, perform the experiment, and capture the results via a picture or video. Pumping compressed air through a tube placed beneath a large portion of sand, forces the sand to change its state. As a result, it behaves as a liquid which allows us to capture a cool phenomenon and record a video showing how the sand state is changing.

The scientific name of the experiment we did is called Fluidized Bed. This is a physical phenomenon where the solid particles of the material behave like a fluid when placed under specific conditions. This is usually done by applying pressurized air through a medium, which in our case was a tube [1]. More on the setup will be explained later. As the air exits the tube in an upward motion, it reduces the friction of the sand, causing it to change its state.

Therefore, what we did as a team to perform and record this experiment was the following, we bought a plastic tub that was approximately 16 x 8 x 8 inches, 30 lbs of sand, and about 4 feet of plastic tubing. Then we borrowed a 150-psi air compressor. First, we drilled small holes on the plastic tube to allow the air to flow out of the tube and to the surface of the plastic tub, then we attached the tube to the bottom of the plastic tub and taped it to ensure that it would not move. Second, we filled a quarter of the plastic tub with sand and ensured it was distributed evenly across the surface of the container. Finally, we charged the air compressor, and turned it on to pump the air through the tube and watched how the sand reacted to the compressed air. The plastic tub was placed on a fixed table and the air compressor was on the floor a couple of feet away. As far as the lighting goes, we used the light in the room where we performed this experiment. The camera was situated 2.5 inches away from the plastic tub. A sketch of our experimental setup is shown below.

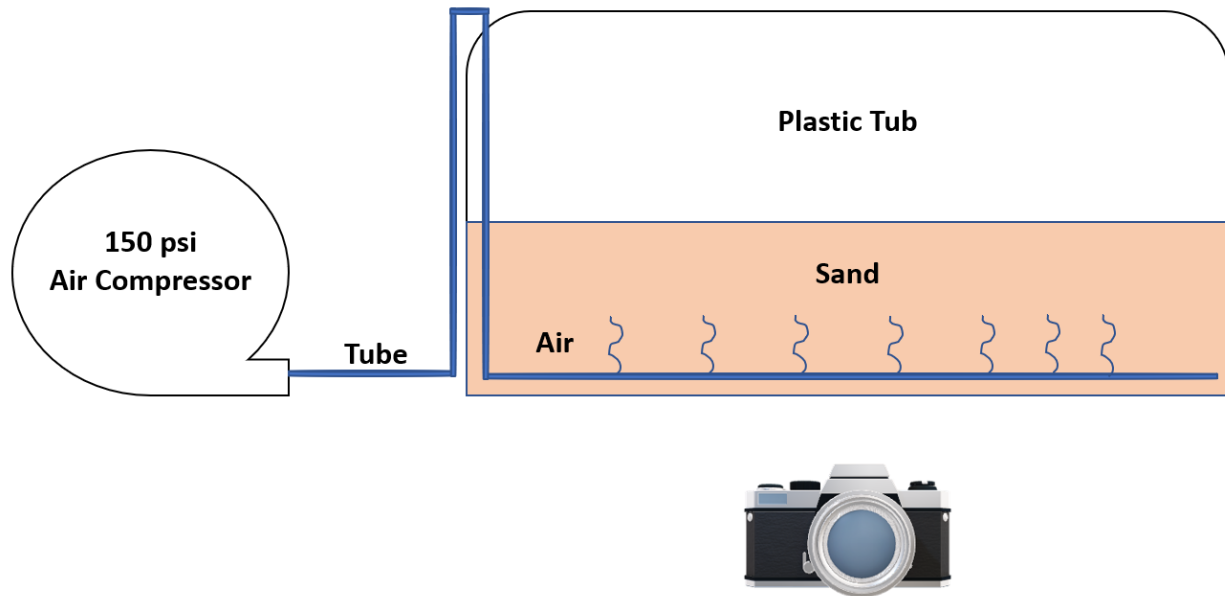


Figure 1. A schematic of the experimental setup generated via PP.

The camera used to record this video was Nikon D3300, placed on the same table as the plastic tub. The lens attached to the camera was Nikon AF-S DX Nikkor 18-55mm f/3.5-5.6G VR II. The video was recorded at a distance of 2.5 inches away from the plastic tub. The video was shot at a frame rate of 59.94 frames/second, so approximately 60 frames/second. The resolution of this video was 1920 x 1080 before cropping the edges. After cropping the video, the resolution decreased to 1280 x 720 pixels. The aperture was set to F/4.2, and ISO was 900. The focal length was 20 mm. The field of view was about 2 by 2 inches. As far as the post-processing goes, I only added a title at the beginning of the video, and collaborators reference at the end of the video. Also, I cropped a little bit of the edges from the original video as mentioned earlier but no other modifications were made and hence no need to provide an after shot of the video. Since both videos look almost the same.



Figure 2. Shows a screenshot from the video.

In conclusion, as a team, we aimed to create a video that captures how the sand changes its state from solid to liquid. What I like about this video is that we were able to capture a region where the phenomenon is clearly demonstrated. However, it is not what we hoped for. We wanted to capture a large portion of the sand as it behaves as a liquid but that did not happen. We believe the reason behind that was, we did not supply enough air through the tube. However, we could not find another air compressor that had a higher rate of power. Also, it might have been better if we used a smaller container which means a smaller area. Therefore, as a future improvement, doing so might result in a better demonstration of the fluidized bed phenomenon.

References

[1] Fluidized bed. (2019, August 22). Retrieved from https://en.wikipedia.org/wiki/Fluidized_bed.