Clay Slip Stirred

By Galen Melchert

https://youtu.be/Hf2V1Rys_Wo

This project was executed as a spur of the moment inspiration. Another artist and myself were working on casting with porcelain slip. The process of mixing the slip was visually enticing and so I decided to film it. I only had my phone, but fortunately it did a good job of imaging the flow. I started by taking pictures of the still slip. It naturally had colorations that created awesome surface patterns. The lighting was not ideal, and so the images had odd reflections. Stirring the slip got rid of these reflections and introduced a satisfying visual stimulus. To accentuate the experience, I recorded the stirring at 240fps.

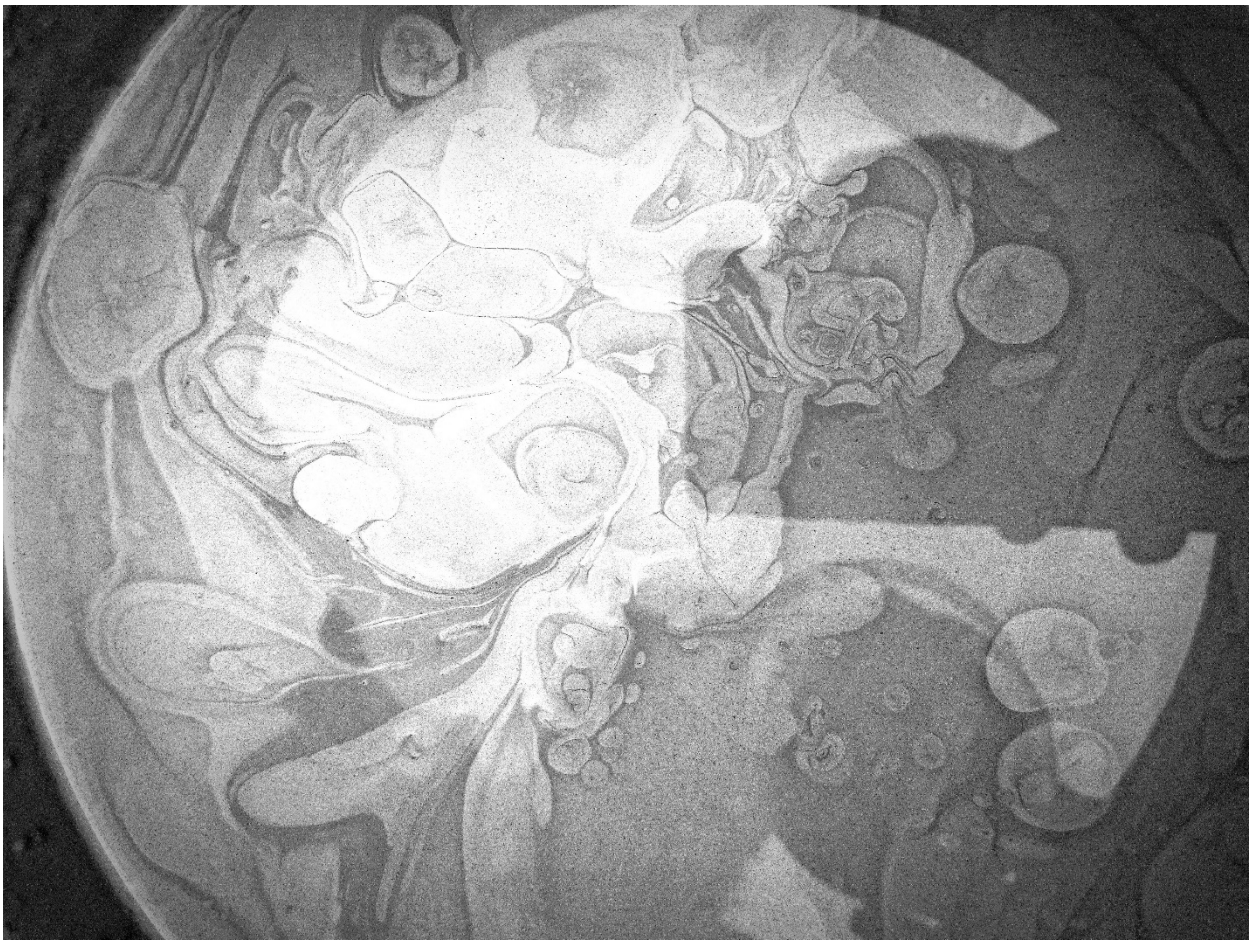

Figure 1: An example of surface features on the clay slip

The setup for this flow capture was a bucket filled with clay and water. A drill with a finned mixer was used to stir the two ingredients. The mixer's speed and position were varied to increase the turbulent nature of flow.

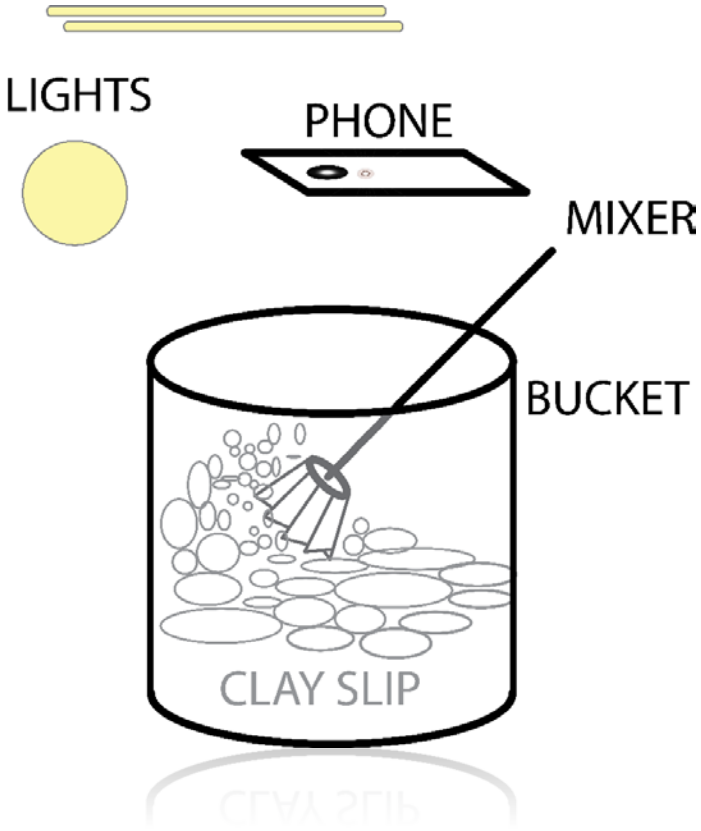

Figure 2: Diagram of setup

The flow has two phase characteristics with turbulence and aeration. (1) Clay slip is a non-Newtonian fluid due to its thixotropic properties. "Thixotropy is the property of clay slip becoming thicker when they are at rest." (2) Essentially the faster you move the clay slip, the less viscous it becomes. This is caused by the increase in shear forces that result in the molecules "slipping". When the power stirring the clay is shut off, the clay's velocity will falloff exponentially. This results in an interesting looking flow that subtly hints to its oddness. The unstirred areas are motionless while the stirred areas are turbulent. Because of this oddness and the nature of the setup I cannot get into Reynolds or Grashof numbers with any hope of accuracy.

The fluid was comprised of porcelain clay and water. The specific gravity was 1.69, just below the recommended level for casting. There was some darker colored streaks in the slip that gave a great visual of currents in the clay. The exact source of the streaks are unknown but could possible be remnants of another clay type. To capture the details of the flow, lighting was used to highlight and cast shadows. The lights used were overhead fluorescent tubes, an incandescent lamp and the flash on the phone. Fluorescents are terrible for slow motion, luckily Samsung averaged out the flicker when played back at 60fps (1/4). I was unable to reduce the speed by 1/8 however because there were not enough frames to average out the flicker. A better lighting setup would have warranted better results.

Filming the slip was a little difficult. Because the bucket was deep, to get close to the slip I had to cover the bucket opening with the phone. This blocked a lot of light. Having a bright light source at the rim would have helped. To get proper lighting the field of view was compromised and included the sides of the bucket and around it. This is what inspired the mirror composition. One bucket alone was too small in the frame. Because the frame was only 1280x720 pixels there wasn't room from crop zooming. Instead I masked the buckets in a color, leaving the slip pool as the only point of attention. A second pool was mirrored both horizontally and vertically and placed next to the first. This filled the frame better and gave for a more immersive and involving experience. I chose to not add music to the composition because there was a cool slow-mo gargle in the background that I liked. However the sound of the drill dominated most of the auditory landscape and thus in hindsight I should have dubbed an audio track.

Figure 3: Unedited screenshot of clay slip flow

The result of all of this was interesting. The video subtly shows the odd nature of a non-Newtonian fluid. I hope to work with clay slip again. It's a lot of fun. For a first try I am satisfied with the result, but there are certainly aspects that could be improved. Mainly the lighting was far from ideal. This hurt the framing and overall workability of what was captured. A bright light at a shallow angle from one side of the bucket rim would have really dramatized the flow dynamics. I'm very curious to try this again – clay slip is awesome.

References

1. *Turbulence, aeration and bubble features of air-water flows in macro- and intermediate roughness conditions.* **Stefano Pagliara, Thendiyath Roshni, Iacopo Carnacina.** June 2011, Water Science and Engineering.

2. **Cameron Tropea, Alexander L. Yarin.** *Springer Handbook of Experimental Fluid Mechanics, Volume 1.* s.l. : Springer, 2007.