Electronic Supplementary Information

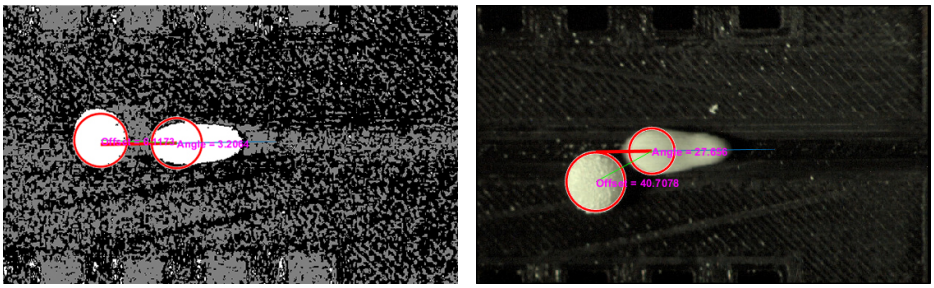
Mapping outcomes of liquid marble collisions

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S1 Velocity and Offset Ratio Determination

Example graphical outputs of the MatLab (MathWorks) code used to identify circles, determine liquid marble (LM) velocity, and calculate the offset ratio of each collision can be seen in figure S1. The code itself is also available (`matlab_code.m`).



(a) (b)

Figure S1: Examples of the output of the MatLab code used to identify circles, and calculate the velocity and offset ratio. Images are given both with initial colour separation (a), and without (b), for clarity. The blue line shows the mobile marble's trajectory in the previous (known) number of frames, the red line shows the predicted onward trajectory, and the green line shows the angle to the centre of the stationary LM (used to calculate the offset ratio).

S2 Particle Size Measurement

The unsieved polyethylene (PE) powder was analysed using scanning electron microscopy (SEM). The particle sizes and distribution was measured using the ImageJ software. A total of 150 measurements were made, yielding a mean of 102 µm and a standard deviation of 35 µm. A plot showing the distribution can be seen in figure S2. Images were gathered using the Everhart-Thornley detector (ETD). The working distance was approximately 9 mm (specifics visible in individual images). The accelerating voltage was either 500 V or 5 kV (specifics visible in individual images). The electron beam diameter spot was 3.0 nm. Example images are shown in figure S3.

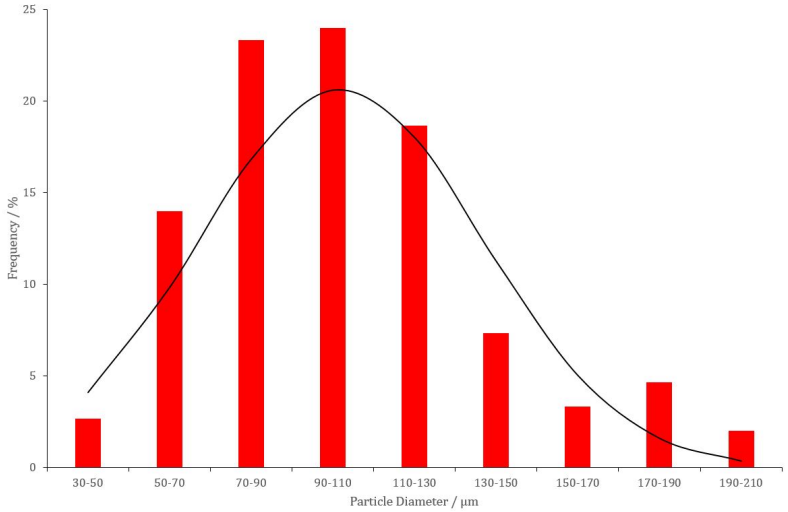
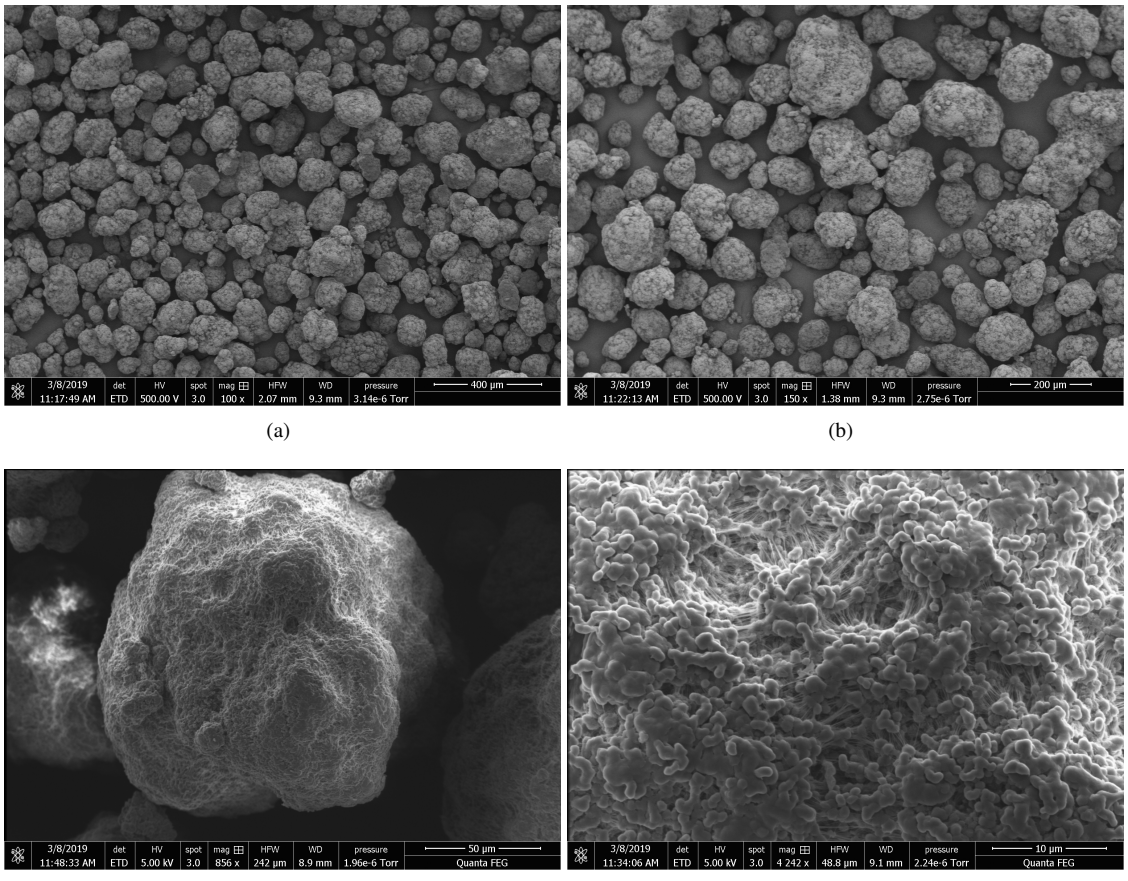


Figure S2: The particle size distribution of unsieved PE powder. Each bin is 20 µm. The red bars indicate the frequency of each bin, and the black line shows the normal distribution probability density function.



(a) (b)

(c) (d)

Figure S3: SEM images of the unsieved PE powder. The scale bar is in the bottom right of each image. The accelerating voltage (HV), magnification (mag), and working distance (WD) can also be seen in each image.

S3 Smaller Marble Collisions

Collisions between LMs with a volume of 10 µL did not result in coalescence, regardless of offset value. The absence of coalescent collisions, irrespective of LM velocity, offset value, and modified Weber number, can be observed clearly in figure S4, which depicts the results of impacts between such LMs. There was one anomalous datum, with parameters $We^* = 3.02$ and $X^* = 0.27$, wherein the LM collision resulted in coalescence. This collision could not be reproduced, and so is absent from figure S4.

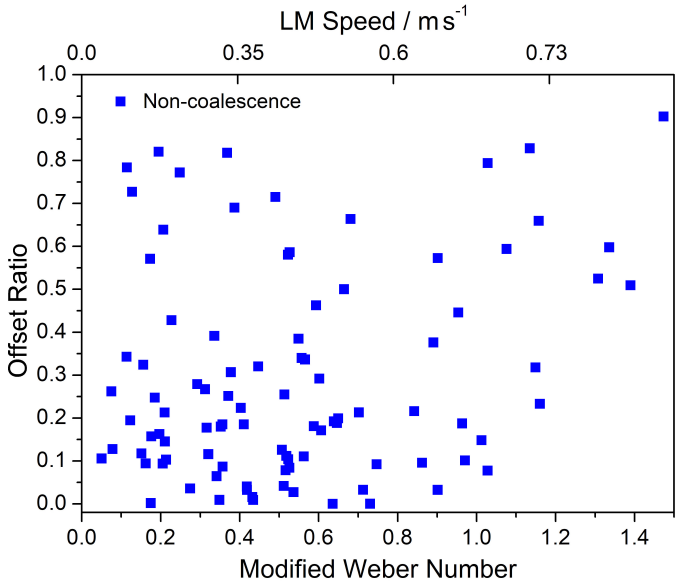


Figure S4: The outcomes of a number of collisions between a mobile and static LM. The blue squares indicate a non-coalescence event. All marbles had a volume of 10 µL and were coated with PE. Measurements were taken by analysis of the recorded high-speed video footage and isolated frames.

S4 Other Supporting Files

Included in the electronic supplementary information (ESI) are videos demonstrating the collision outcomes discussed. A description of these videos can in found in table S1. Also included is the CAD file for the 3D printed collision rig (`collision_rig.stl`), and the MatLab code used for collision analysis (`matlab_code.m`).

Table S1: Descriptions of the videos included in the ESI.

File Name	Description
Offset 0-05 to 0-35	Video of the collision shown in figure 3
Large offset	Video of the LM collision shown in figure 4
Small offset	Video of the LM collision shown in figure 5
Coalescence	Video of the coalescing LM collision shown in figure 6
Water	Video of water droplet collision shown in figure 10