By setting $v^{\perp} = V\hat{v}^{\perp}$, where V is the boundary velocity and $\hat{v}^{\perp}$ is our rescaled dimensionless velocity, we can rewrite our equation of motion as

$$(\lambda V)\hat{v}^{\perp}(s) = \Delta P - \gamma K(s) \tag{6}$$

It is clear that, given any initial state configuration, its development in time is determined by λV. Furthermore, we see evidence of this λV dependence if we rewrite the Herschel-Bulkley relation (see eq. 1) in terms of our VF parameters. As stress in 2D has dimensions of force per length, on dimensional grounds, we see that

$$\sigma = \sigma_y + \hat{c_v}\gamma^{1-a}\bar{A}^{a-1/2}L^{-a}(\lambda V)^a \tag{7}$$

where the 2D surface tension γ has dimensions of force, λV has dimensions of force per length and $\hat{c_v}$ is a dimensionless parameter of order unity which may be related to $\mu_2(A)$. In this derivation, we define the strain rate term of eq. 1 as the nominal shear rate of the system, $\dot{\epsilon} = V/L$.

To calculate flow profiles, bubble centre positions are determined. We subsequently divide our foam into bins of width W_l and calculate the average velocity of bubbles centres in each bin over time. A sketch of our simulation setup is illustrated in Fig. 4 (polydisperse sample).

Fig. 5 shows examples of averaged steady state velocity profiles. We say that a simulation has reached a steady state once there is no longer any appreciable change in our velocity profile in time. Typically, we average our steady state velocity profiles over the range $1 \leq \epsilon \leq 10$, where the imposed strain ϵ is defined as $\epsilon = \Delta x/L$ and Δx is equal to the total displacement of the moving boundary. Note that there is a clear change in the flow profiles as we vary λV. We find that localisation occurs close to the moving boundary in all but two of our simulations. (In one of these cases, for $\lambda V = 0.01\ \gamma\bar{A}^{1/2}$, localisation switches to the stationary boundary, while in the second case, for $\lambda V = 0.005\ \gamma\bar{A}^{1/2}$, a shear band occurs in the centre of the sample away from either boundary (data not shown).) Localisation of flow can also be made visible by plotting the positions at which T1 topological changes occur in our samples, as done by [33]. An example is shown in Fig. 6.

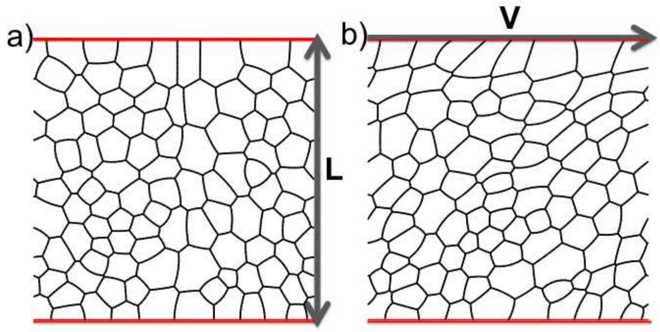

Fig. 4 (a) A polydisperse foam consisting of 100 bubbles (Sample 5) in equilibrium. L denotes our system size. (b) The same foam being sheared at a velocity V.

At this stage, it is unclear what the form of the velocity profiles is. We have attempted to use exponential fits and fits from the general Continuum Model [28] in the data fitting process but this approach does not yield consistently good fits to our velocity profiles which are