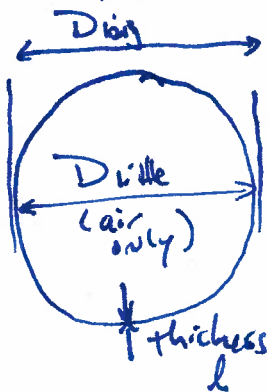Find thickness of gum in bubble before popping,
8g of gum w/ density of $1 g/cm^3$

1st note that not all of the gum will be in the form of a bubble

we estimate that 1g of gum is actually participating in the bubble.

while the bubble isn't a sphere, it is what we will model it as & will use 2 spheres to analyze the problem,
- a bigger one, D_{big} which has gum & air.
- a littler one, with just air in it, D_{little}.

So for 1g of gum we find the volume by:

$$V_{gum} = \frac{M_{gum}}{\rho_{gum}} = \frac{1g}{1 g/cm^3} = 1 cm^3$$

and $\xrightarrow{gum \& air}$ $\xrightarrow{just air}$

$$V_{gum} = V_{big} - V_{little}$$

note $D = 2R$

$$1 cm^3 = \frac{4}{3}\pi R_{big}^3 - \frac{4}{3}\pi R_{little}^3$$

$$= \frac{4}{3}\pi \left(\frac{D_{big}}{2}\right)^3 - \frac{4}{3}\pi \left(\frac{D_{little}}{2}\right)^2 = \frac{\pi}{6} D_{big}^2 - \frac{\pi}{6} D_{little}^2$$

looking at sketch
$$D_{big} = D_{little} + 2\ell \quad or \quad D_{little} = D_{big} - 2\ell$$

so
$$1 cm^3 = \frac{\pi}{6}\left(D_{big}\right)^3 - \frac{\pi}{6}\left(D_{big} - 2\ell\right)^3$$

we further estimate that D_{big} is 7cm

So

$$1 cm^3 = \frac{\pi}{6}(7cm)^3 - \frac{\pi}{6}(7cm - 2l)^3$$

$$1 cm^3 = 179.594 cm^3 - \frac{\pi}{6}(7cm - 2l)^3$$

$$-178.594 cm^3 = -\frac{\pi}{6}(7cm - 2l)^3$$

$$341.090 cm^3 = (7cm - 2l)^3$$

$$6.987 cm = 7cm - 2l$$

$$-0.013 cm = -2l$$

$$0.0065 cm = l$$

So   0.0065 cm is the thickness of the bottle