

Goutte soufflée : croissance et dynamique d'une goutte cisaillée par un écoulement d'air

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Introduction



Figure – Pare brise

Anémomètre à fil chaud

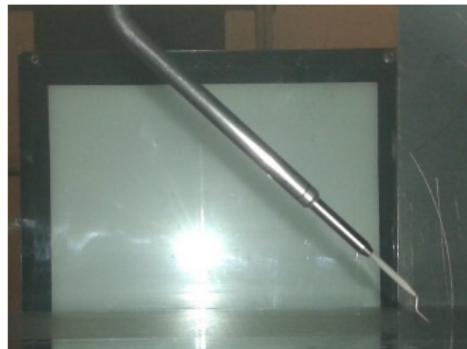


Figure – Mesure avec le fil chaud

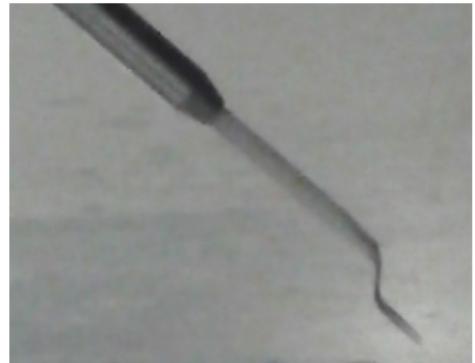


Figure – Fil chaud proche de la paroi

Couche limite de Blasius : Comparaison profil Blasius et expérience

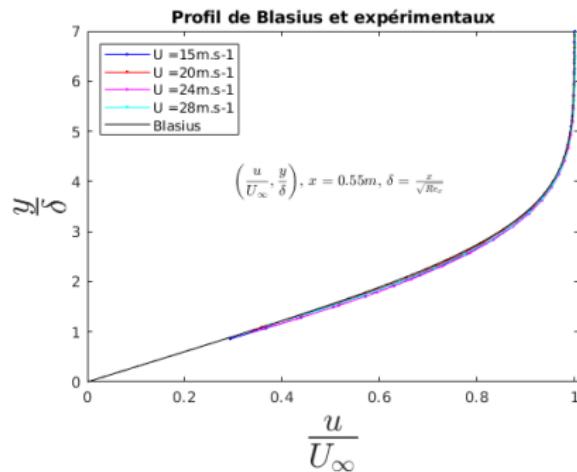


Figure – Profil de Blasius et expérimentaux

Couche limite de Blasius

$$\delta_1(x) = \int_0^{\infty} \left(1 - \frac{u}{U}\right) dy \approx \frac{1.72x}{\sqrt{Re_x}} \quad (1)$$

$$\delta_2(x) = \int_0^{\infty} \frac{u}{U} \left(1 - \frac{u}{U}\right) dy \approx \frac{0.664x}{\sqrt{Re_x}} \quad (2)$$

$$C_f(x) = \frac{2\tau_{y=0}}{\rho U^2} \approx \frac{0.664}{\sqrt{Re_x}} \quad (3)$$

Couche limite de Blasius : nombre de Reynolds

$$x = 0.55m, \quad Re_x = \frac{Ux}{\nu}, \quad \nu = 1.5e - 5 m^2.s^{-1} \quad \text{à} \quad T = 25^\circ C$$

$U(m/s)$	Reynolds
15	550000.00
20	733333.33
24	880000.00
28	1026666.7

Table – Nombre de Reynolds Re_x

Couche limite de Blasius : Comparaison δ_1 Blasius et expérience

$U(m/s)$	$\delta_{1Blasius}(mm)$	$\delta_{1Experience}(mm)$	erreur relative
15	1.27	1.24	2.69%
20	1.11	1.10	0.61%
24	1.02	0.99	3.13%
28	0.96	0.95	1.55%

Table – Comparaison épaisseur de déplacement δ_1

Couche limite de Blasius : Comparaison δ_2 Blasius et expérience

$U(m/s)$	$\delta_{2Blasius}(mm)$	$\delta_{2Experience}(mm)$	erreur relative
15	0.49	0.47	3.64%
20	0.43	0.41	4.62%
24	0.40	0.37	6.08%
28	0.37	0.35	6.92%

Table – Comparaison épaisseur de quantité de mouvement δ_2

Couche limite de Blasius : Comparaison C_f Blasius et expérience

$U(m/s)$	$C_{fBlasius}$	$C_{fExperience}$	erreur relative
15	8.92e-04	9.19e-04	2.89%
20	7.77e-04	7.67e-04	1.31%
24	7.20e-04	7.33e-04	1.85%
28	6.75e-04	6.67e-04	1.26%

Table – Comparaison coefficient de frottement C_f

Dispositif expérimental : Camera, surface et écran à laser

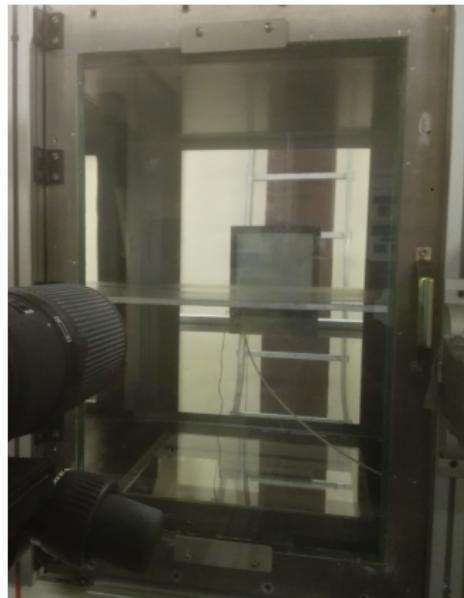


Figure – Camera, surface et écran à laser

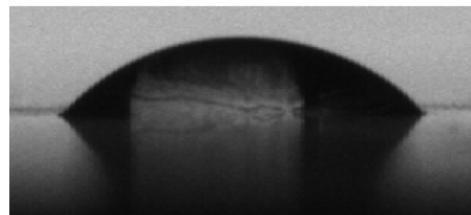


Figure – Goutte d'eau de volume 0.03ml

Dispositif expérimental : Ecran d'observation et séringue

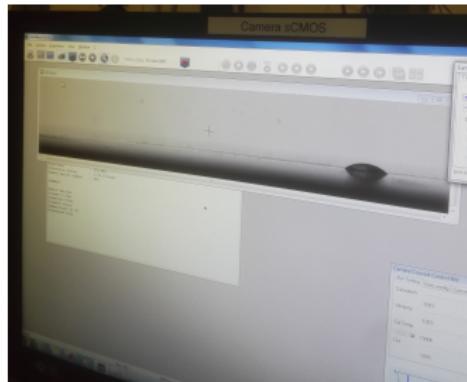


Figure – Ecran d'observation



Figure – Seringue

Paramètres mesurés

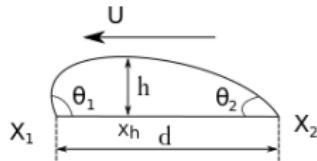


Figure – Paramètres mesurés

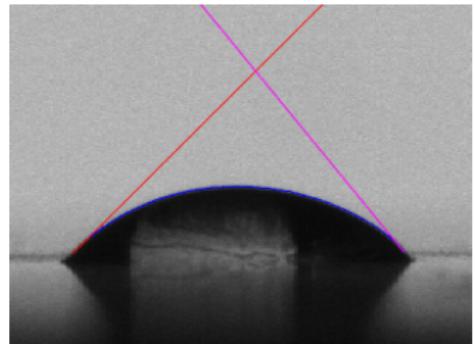


Figure – Goutte d'eau de volume 0.03ml avec :
 $U = 0$, $\theta_1 = 45^\circ$,
 $\theta_2 = 50.17^\circ$, $x_1 = 14.66mm$,
 $x_2 = 6.77mm$,
 $d = 7.89mm$, $h = 4.86mm$
et $x_h = 11.08mm$

Analyse des données : oscillations

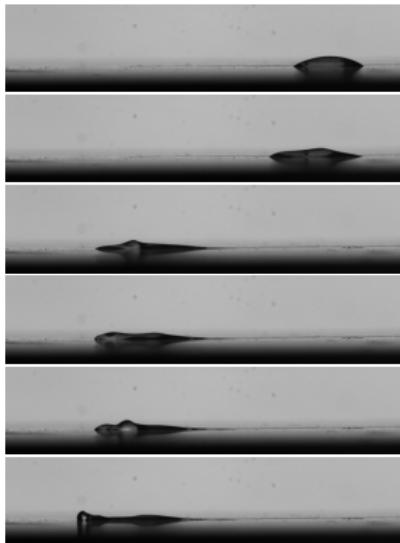
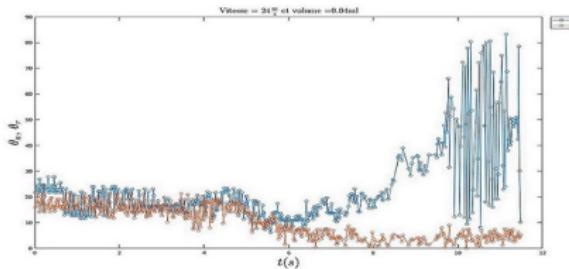
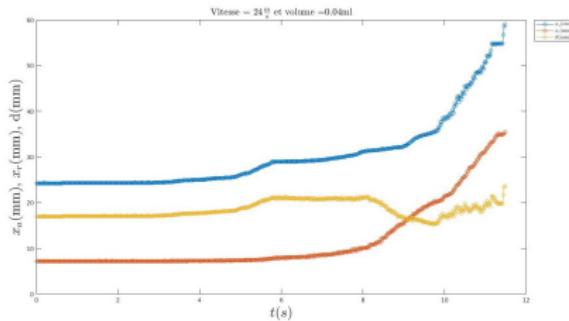
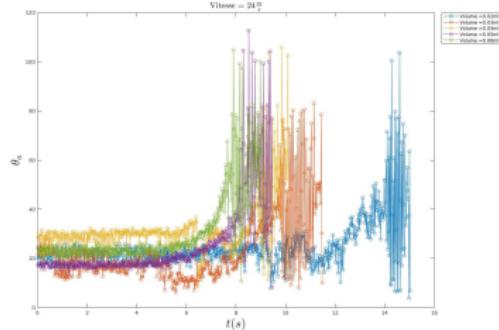
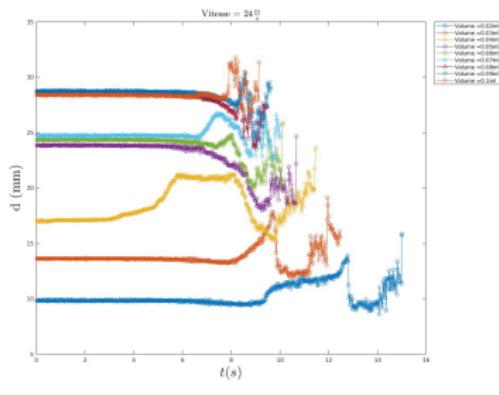


Figure – $U_\infty = 24 \text{ m.s}^{-1}$, de haut en bas nous avons :
 $t = 0\text{s}, 8\text{s}, 12.52\text{s}, 12.54\text{s}, 12.58\text{s}$

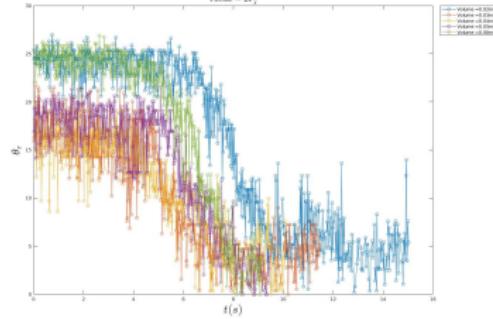
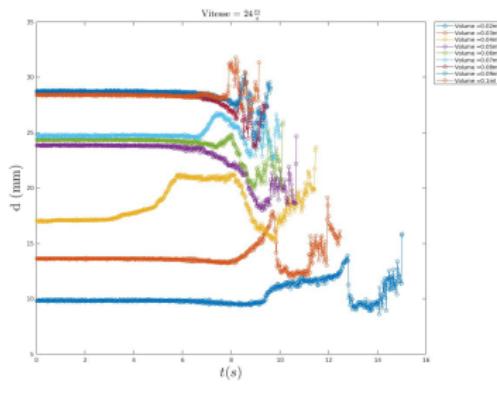
(x_a, x_r, d) , $(\theta_a$ et $\theta_r)$, $U_\infty = 24 m.s^{-1}$ et volume = $0.04 ml$



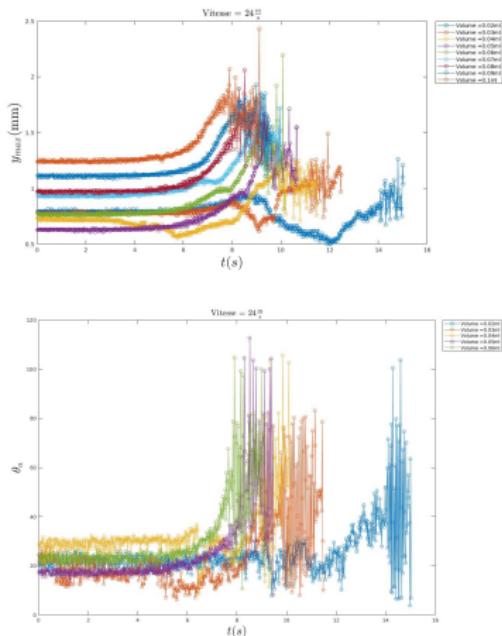
d, θ_a pour $U_\infty = 24 m.s^{-1}$



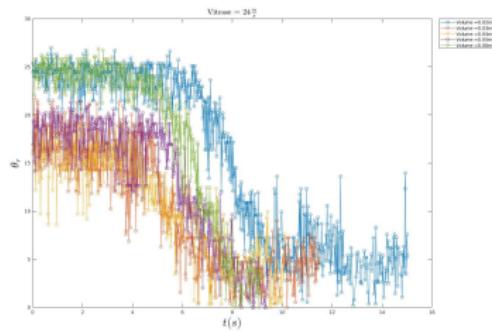
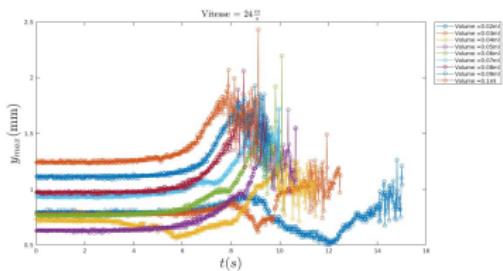
d, θ_r pour $U_\infty = 24 m.s^{-1}$

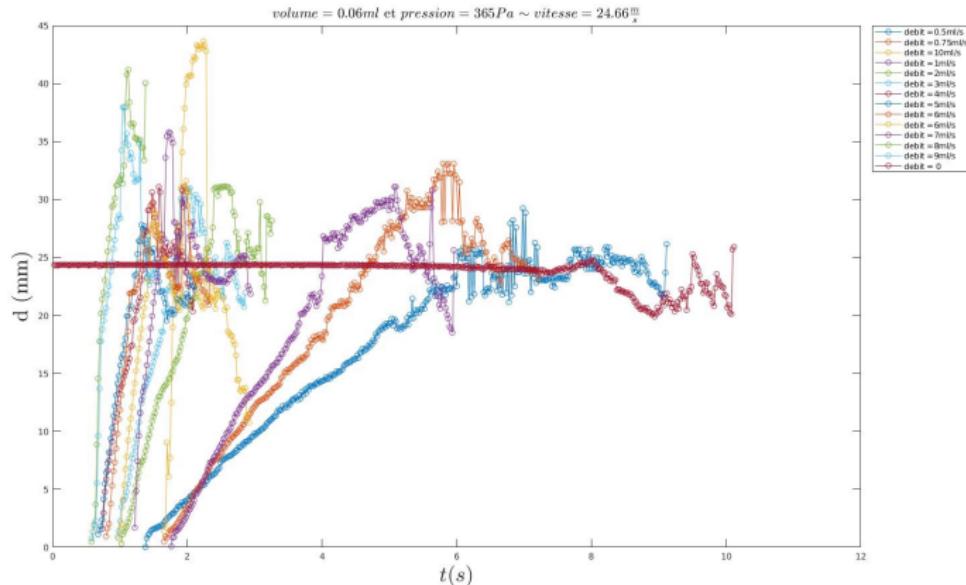


y_{max} , θ_a pour $U_\infty = 24 m.s^{-1}$

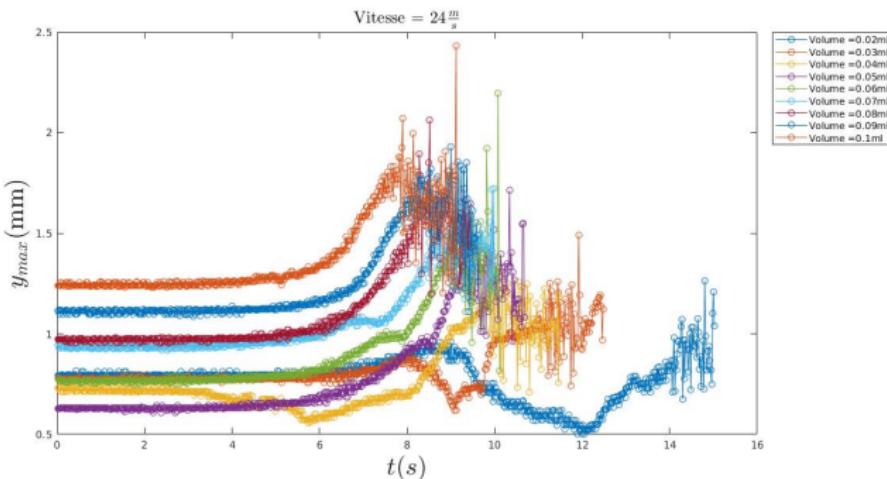


y_{max} , θ_r pour $U_\infty = 24 m.s^{-1}$



Analyse des données : longueur d avec et sans debitFigure – d , volume = 0.06ml, vitesse $\approx 24.7 m.s^{-1}$

Conclusion et perspectives

Figure – y_{max} , $U_\infty = 24 m.s^{-1}$

Questions

Avez-vous des questions ?