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Research Article

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Water Jet Applied to an Object Floating on Water. Part 1: Parallelepiped Shape Object. Investigation of a Braking Phenomenon by the Venturi Effect.

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Abstract
The action of a water jet on a rectangular shape object causes its attraction under the effect of the creation of a depression due a priori, to the Venturi effect known in fluid mechanics. The actual observation has been made. We are trying here to find an explanation for this paradoxical phenomenon. Apart from braking, the phenomenon can be applied for recoil, propulsion of an object floating on the water, as well as its rotation in one direction and the other.

Keyword: Braking, Object Floating, Venturi Effect, Water Jet.

Introduction

It is well-known that while applying a jet of water to the back of an object, of an unspecified form, and located to a flat ground will advance, however a paradoxical phenomenon was observed under the effect of the action of a water jet to the back of a floating object: instead of making it push, it makes it move back. It is wished that this study contributes to better understanding the phenomenon and to introduce its potential applications. In this first part, we treat the braking of parallelepiped objects. Cylindrical and spherical shapes will be treated in part 2.

Figure 1: Attraction by a water jet of an object floating on water. Photo Ben Slama R. 2017

Many photos and videos have been taken on this phenomenon and for objects of different shapes: parallelepiped, cylindrical and spherical.
Attempts to explain the phenomenon have taken place. At first it was thought that it was the turbulence of the water in emulsion with air which was under the floating object caused enough force to make it brake.
Subsequently, it has been found that similar phenomena are described in the bibliography and known as the Venturi effect.

Bibliographic studies

The movement of a fluid around an object creates pressures (depression) on one side more than the other. This phenomenon turns out to be well known in fluid mechanics and designated by the Venturi, Coanda, Robin effect for fixed objects with water or air circulation. If the object turns in addition, we speak of the Magnus effect.

The Venturi effect

It is known that by passing through a narrowing or throttling of a duct, a fluid sees its speed increase and suddenly its pressure decreases.

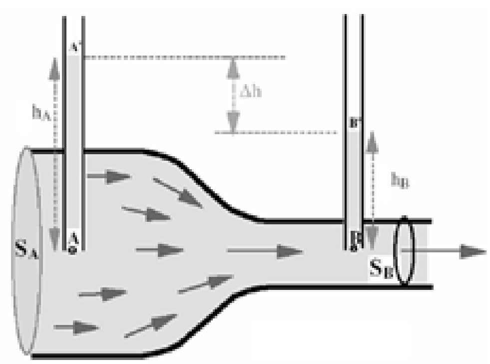


Figure 2 : Pressure variation following the section variation

Indeed, the conservation of the mass flow (□ = cste), allows to write:

$S_1.V_1=S_2.V_2$

$$S_1.V_1 = S_2.V_2$$

hence $\frac{V_2}{V_1} = \frac{S_1}{S_2}$

from where,

$$V_2 = V_1.\frac{S_1}{S_2} > V_1$$

By applying Bernouilli's theorem:

$$p_1 + \frac{1}{2}.\rho.V_1^2 = p_2 + \frac{1}{2}.\rho.V_2^2$$

from where :

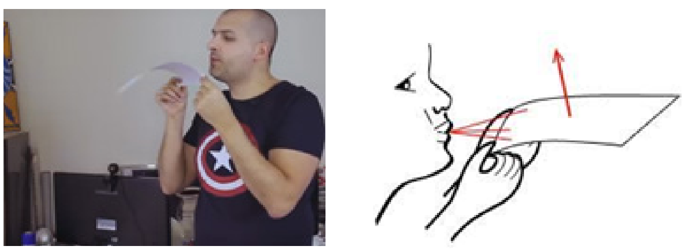
$$p_2 = p_1 + \frac{1}{2}.\rho.(V_1^2 - V_2^2)$$

$$p_2 = p_1 + \frac{1}{2}.\rho.V_1^2\left(1 - \left(\frac{V_2}{V_1}\right)^2\right) = p_1 - \frac{1}{2}.\rho.V_1^2\left(\left(\frac{V_2}{V_1}\right)^2 - 1\right)$$

$$p_2 = p_1 - \frac{1}{2}.\rho.V_1^2\left(\left(\frac{S_1}{S_2}\right)^2 - 1\right)$$

Venturi effect experience:

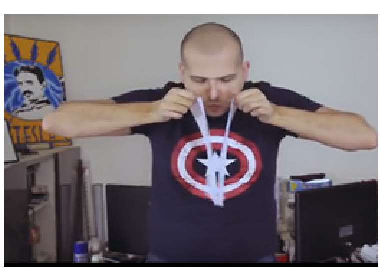
A leaf rises under the effect of a blowing above.



http://lesflousduvolant.com/index.php/2017/11/07/effet-venturi-notion-sert-a/

Figure 3: Depression created by the air speed between two sheets of paper.

By blowing between two leaves, they approach rather than move away.



The Venturi effect allows aircraft to fly: creating a depression on the upper surface (above) and overpressure on the lower surface (below). Indeed, above the wing, the length of the air path is longer than below, then the speed is greater above, thus a lower pressure, therefore a depression.

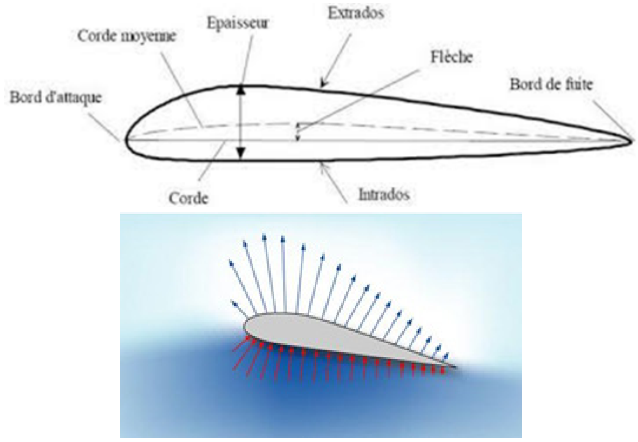
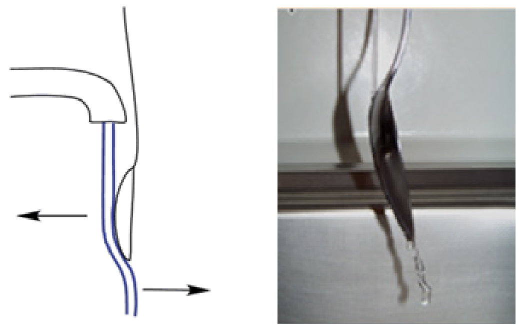


Figure 4 : Pressure profile around an airplane wing.

Attraction of a spoon by the water jet from a tap.



https://www.boomerangs.com/pages/aerodynamics-of-boomerangs

Figure 5: Attraction of a spoon by the water jet from a tap.

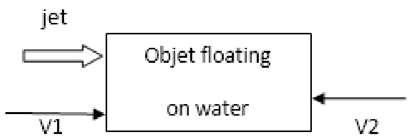
The water jet coming from a tap, passing over the outer surface of a spoon creates a depression which causes the spoon to move back, tilt it because it is kept articulated from above.

Attempt to explain the action of a water jet on the braking of a parallelepiped floating object

Probably, the effect of the speed of the water induces a depression which sucks the object backwards. Indeed, according to Bernouilli's theorem:

And if the force does not allow the stability of the object; then it swings around a central point.

Figure 6 : Object floating on water. Photo Ben Slama R.



V1: speed of the water jet relative to the object.
V2: speed of the water in the basin in relation to the object

$$p_1 + \frac{1}{2}.\rho.V_1^2 = p_2 + \frac{1}{2}.\rho.V_2^2$$

Now, $V_2 = 0$ Hence:: $p_1 = p_2 - \frac{1}{2}.\rho.V_1^2 = p_{at} - \frac{1}{2}.\rho.V_1{}^2$

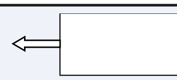
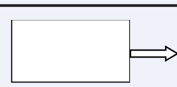
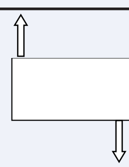
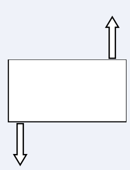
$$hence \quad p1 < p2$$

We overlooked the effect of height.

The pressure difference between the front and the back of value: $1/2.\rho.V_1{}^2$ induces an action on the surface of the object directed towards the rear (opposite direction of the jet) and intensity: : $1/2.\rho.V_1{}^2.S$

Outlook: movement forward and turn

In addition to rear braking, the water jet phenomenon can be used for forward propulsion and also the left and right turn depending on the location of the water jet.

retreat	Rear dépressions	
Advanced	Front depression	
Right turn	Two clockwise depressions	
Left turn	Two depressions in the counterclockwise direction	

Conclusion

The braking of a floating object by water jet is actually due to the depression created by the speed of the water which is greater on one side of the object than on the other. So it's not due to the turbulence created below the object as we can see, which is misleading. The value of the braking force remains to be determined; is it sufficient to stop a ship of known mass and speed and after how long?

As a possible application, we can cite the braking of boats at sea, particularly those that are drifting or fishing.

A deepening of this theme is to be followed both theoretically and experimentally.
The force of attraction created can also allow not only the braking of floating objects but also their forward projection and their right and left turn.

References

1. http://lesflousduvolant.com/index.php/2017/11/07/effet-venturi-notion-sert-a/.
2. https://www.boomerangs.com/pages/aerodynamics-of-boomerangs.
3. https://www.lavionnaire.fr/TheorieFredMon.php#TheoRicochet.H
4. https://www.sciencesetavenir.fr/fondamental/une-stupefiante-demonstration-d-un-effet-physique-en-video_23303.
5. https://fr.wikipedia.org/wiki/Turbovoile.
6. http://fred.elie.free.fr/turbovoile.pdf.
7. https://fr.wikipedia.org/wiki/Effet_Magnus_et_turbulence_dans_le_football.
8. https://www.futura-sciences.com/planete/actualites/energie-renouvelable-challenergy-eolienne-tire-son-energie-typhons-64598/.
9. https://bfmbusiness.bfmtv.com/entreprise/ces-etonnantes-eoliennes-japonaises-peuvent-resister-aux-typhons-1131878.html.
10. https://fr.scribd.com/doc/143944614/Hydrodynamique-Physique.
11. Etienne Guyon, Jean-Pierre Hulin, Luc Petit Hydrodynamique Physique. CNRS Editions Paris 600.
12. Henri BROCH Professeur émérite de Physique et de Zététique. Livre Mécanique des Fluides (2016) Université Nice Sophia Antipolis.