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A1_5 Draining the Mediterranean

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Abstract

This paper investigates one possible method of draining the Mediterranean Sea via the use of a siphon system. We found with one pipe approximated to those used in the hoover dam it would take almost 10000 years, however when the dam is scaled up to cover the strait of Gibraltar the time is reduced to 35 years. Making it a feasible although unlikely engineering project.

A1_5 Draining the Mediterranean

Introduction

Many works of Science Fiction refer to the idea of damming the straits of Gibraltar with the aim of draining the Mediterranean to produce farm land and establish additional links between Europe and Africa and irrigate the Sahara. It was actually proposed by German architect Herman Sörgel in the 1920s as an alternative to war that would provide the peoples of Europe with space to expand and live in harmony.[1] This paper will examine the use of a siphon to drain the Mediterranean determining its practicality.

Theory

We will imagine a system where water is drained from the Mediterranean by huge pipes into containers a distance d bellow the end of the pipe. To completely train the Mediterranean they would need to be below the level of the bottom of the sea. One possibility would be a subterranean tunnel from which the containers are removed to another location e.g. desert, and need no longer be considered.

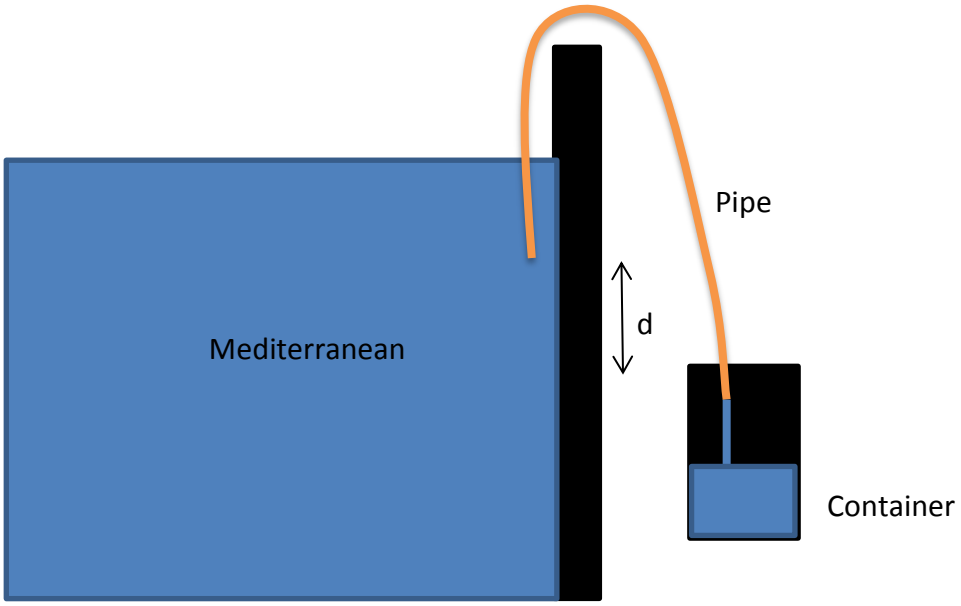

Fig 1 shows a siphon system where d is the difference between the vertical displacements of both ends of the Pipe.

We start with Bernoulli's equation,

$$P + \rho g y + \frac{1}{2}\rho v^2 = \ constant \ . (1)$$

Where P = pressure, ρ = density, g = acceleration due to gravity, y = vertical displacement and v = velocity of the flow. We consider this for both ends of the pipe and equate them.

$$P_m + \rho g y_m + \frac{1}{2}\rho v_m^2 = P_c + \rho g y_c + \frac{1}{2}\rho v_c^2. \quad (2)$$

Subscript m denotes Mediterranean and c denotes container. The pressure in both cases is atmospheric and as such will cancel out. We take y_m to be 0 and y_c to be -d. The velocity in the sea is 0 and velocity of flow into the canister is to be found. ρ also cancels. This gives us;

$$g(0) + \frac{1}{2}(0) = -gd + \frac{1}{2}v_c^2, \quad (3)$$

This rearranges to give us,

$$v_c = \sqrt{2gd}\ . \quad (4)$$

Knowing the velocity of flow we can work out the volume per second drained from the sea by multiplying it by the cross sectional area of the pipe.

$$volume\ per\ second = \pi r^2\sqrt{2gd}\ . \quad (5)$$

Where r is the radius of the pipe. Then if we know the volume to be drained we can calculate the time taken.

$$t = \frac{V}{\pi r^2\sqrt{2gd}}, \quad (6)$$

Where t = time in seconds and V is volume in m^3.

Discussion

We can calculate the volume of the sea as we know its surface area is $2.5\text{x}10^6$ km^2 ($2.5\text{x}10^{12}$ m^2) and average depth of 1500m giving a volume of $3.75\text{x}10^{15} m^3$.

If we assume a height similar to that of the hoover dam of 220m. [2] We also consider pipe diameter similar to its 15.25m giving a radius of 7.625m. [2]

These can all be used in equation (6) to determine the time drain the sea.

$$t = \frac{3.75\text{x}10^{15}}{\pi(7.625)^2\sqrt{2(9.81)(220)}} = 3.12\text{x}10^{11} \text{ seconds or 9902 years,}$$

However it seems unlikely that such a large dam would have a single pipe. The strait of Gibraltar are approximately 14km across [3] so if there was a pipe every 50m then the material would flow 280 times as fast.

$$t = \frac{3.75\text{x}10^{15}}{280\pi(7.625)^2\sqrt{2(9.81)(220)}} = 35 \text{ years 133 days,}$$

Conclusion

This would still be an extremely long term project without even taking the construction time or cost of materials into account. However it is physically possible to do in one lifetime although it would not work perfectly as the deepest parts of the sea would become salt water lakes. But in less than a lifetime with the system proposed above Europe and Africa could be united into one continent.

References

[1] http://www.scifiideas.com/related/atlantropa-draining-the-mediterranian-sea/ accessed 13/11/12 22:33
[2]http://www.usbr.gov/lc/hooverdam/faqs/damfaqs.html 13/11/12 23:00
[3] http://www.worldatlas.com/aatlas/infopage/gibraltar.htm accessed 13/11/12 23:10