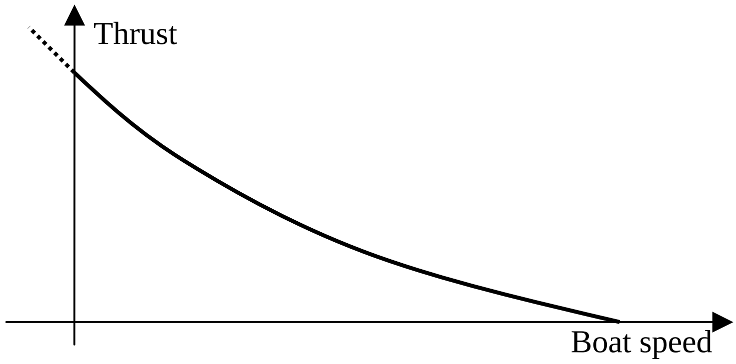
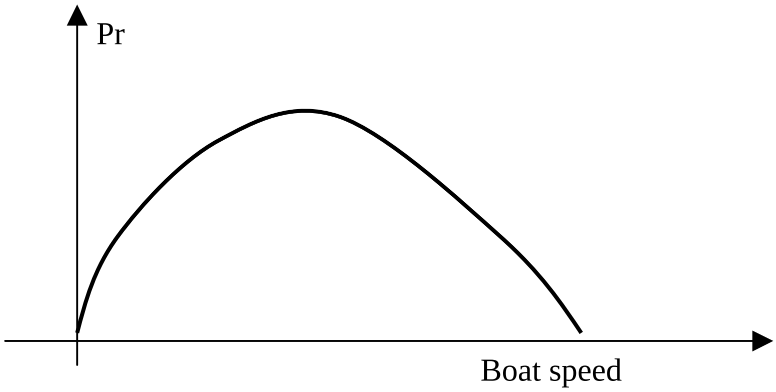
Pop-pop engine/hull adaptation

By Jean-Yves

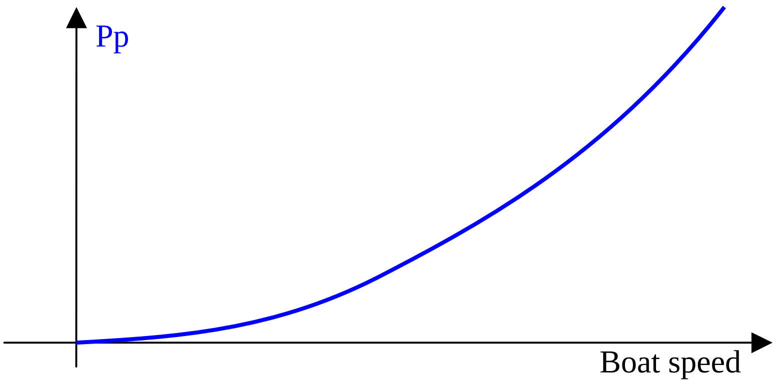
The thrust developed by a given pop-pop engine depends on the speed of the hull on board which it is fitted. It is big at bollard pull conditions, decreases when the speed increases, and becomes null for a certain speed of the boat.





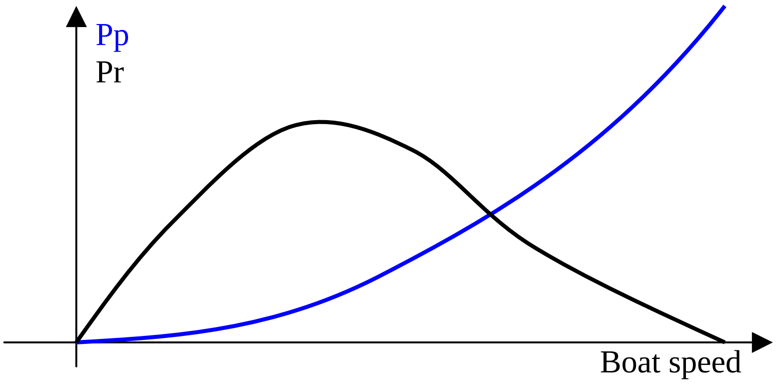
L The mechanical power propelling the boat (Pr=restituted power) is the product of the thrust T by the boat speed. It is null at bollard conditions, increases with the speed, goes to a maximum, and then decreases and becomes null (for the same speed as for the thrust).

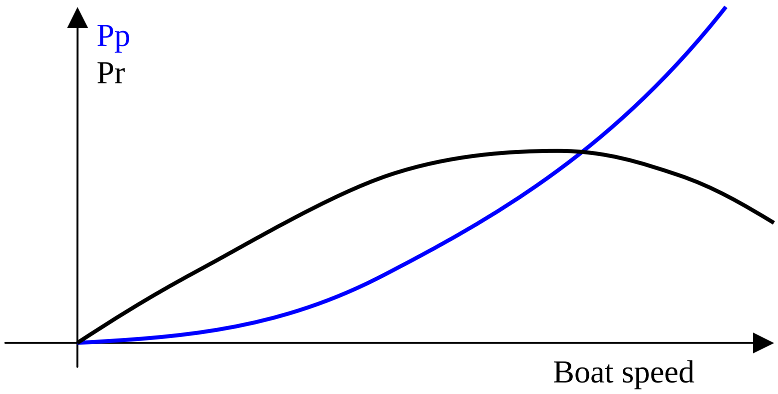
The power needed to propel the boat (Pp) increases quickly with the speed. At low speed, it is a cubic.



The curves Pr and Pp can be represented on a single diagram.

The intersection corresponds to the working conditions. Its abscissa defines the speed and its ordinate defines the working power.

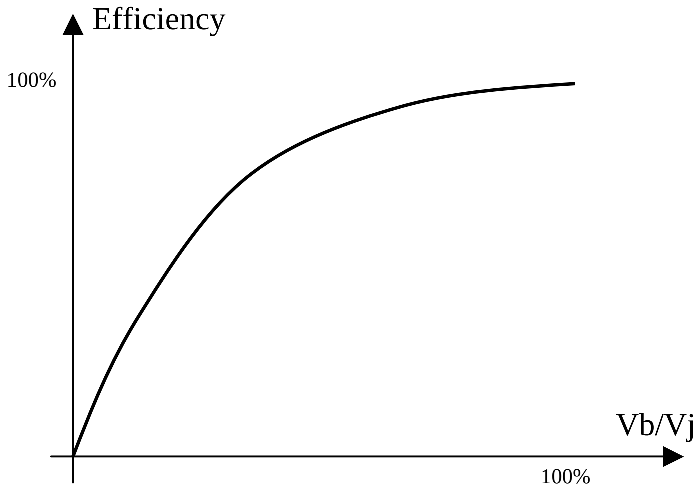




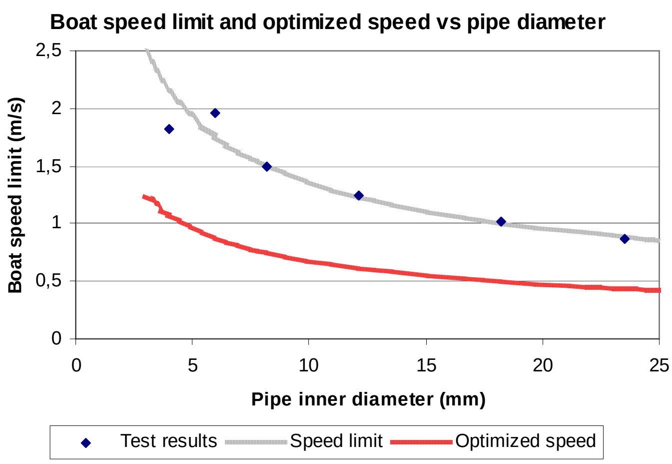
The engine/hull adaptation is good when the curves are crossing each other as far as possible from the origin, and where the restituted power is close to the maximum.

The hydrodynamic efficiency is to be taken into account as well. It increases when the velocity of the water (Vj) hurled back is close to the one of the boat (Vb). For a direct flow waterjet, the curves looks like the one on the right.

But it is not enough. Other considerations such as weight, size…and cost, are to be looked at. As often, compromises are to be found and, to do so, the design process is iterative.



All this has been set in black on white because it applies to the pop-pop propulsion, but it is more general. What follows is more specific to pop-pop propulsion. On one hand the thrust decreases linearly when the boat velocity increases. The speed at which the thrust becomes null is called the “limit speed”. It is the best theoretical speed that could be reached by a dragless boat. On the other hand, a pop-pop engine delivers its best power when the boat speed is half the limit one. (To check these two assertions, see “Pop-pop propulsion and momentum theory”). In addition, results of tests of several engines allowed defining the evolution of the limit speed versus pipe inner diameter.



This graph set as evident the fact the speed of a boat propelled by a pop-pop engine is slow. Furthermore, it decreases when the size of the engine increases. Several small engines are preferable to a single big one.