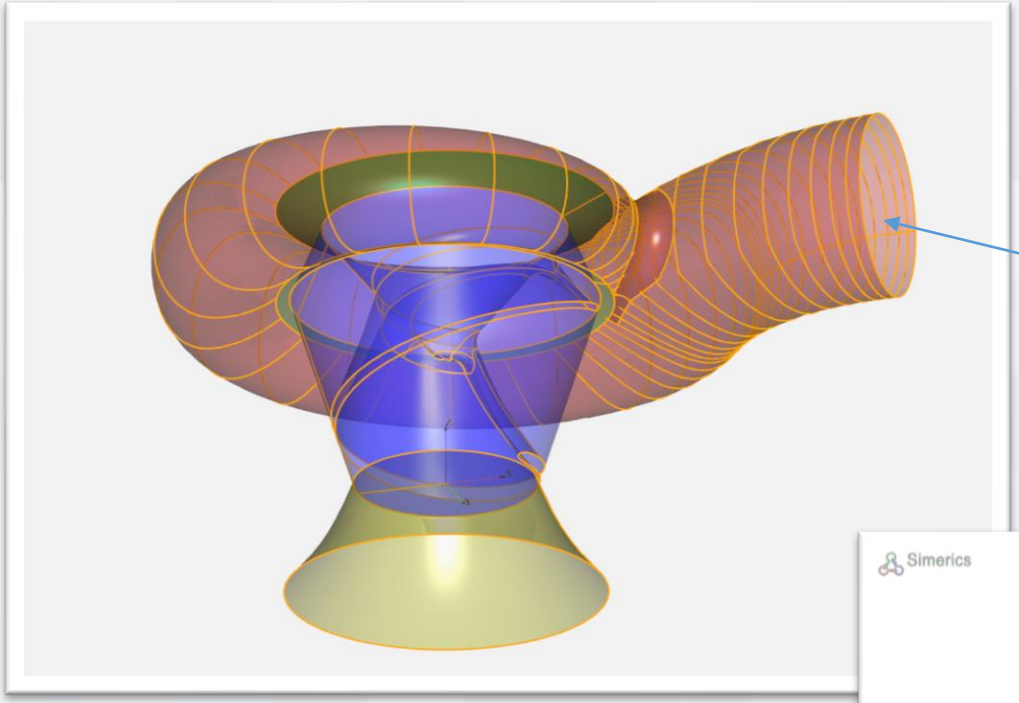
innovation fluïd systems & pump engineering

STUTTGART | 04-02-2020

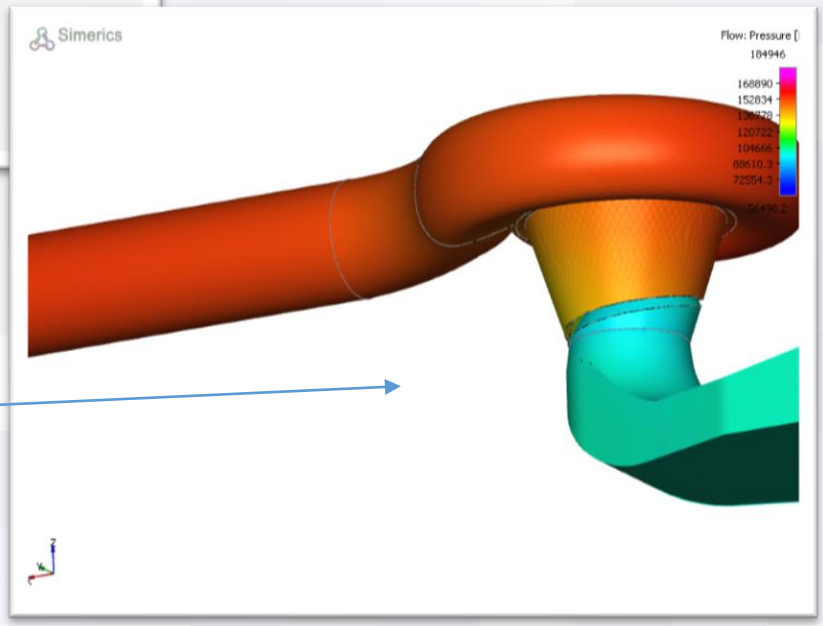
DESIGN FISH FRIENDLY PUMPS

CFturbo is used for pump design
Simerics is used for simulation

Hoekerweg 1 | 8042 PH Zwolle | The Netherlands | +31 (0) 6 48 96 16 23 | hans.hofmeijer@skeletline.nl | www.skeletline.nl



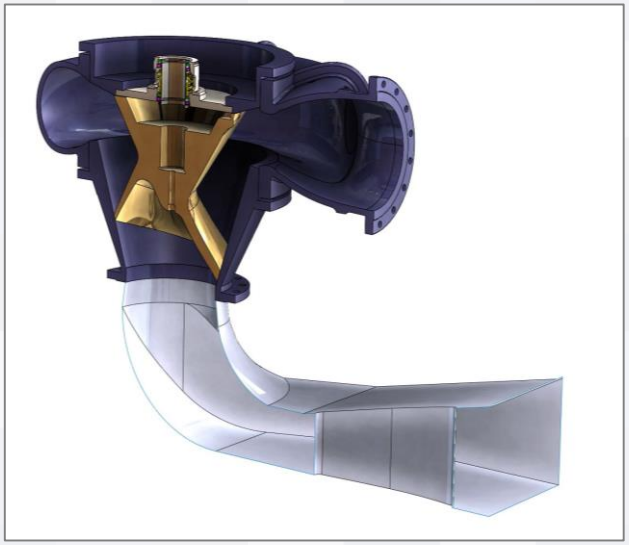
CFTURBO GEOMETRY DESIGN



SIMERICS SIMULATION

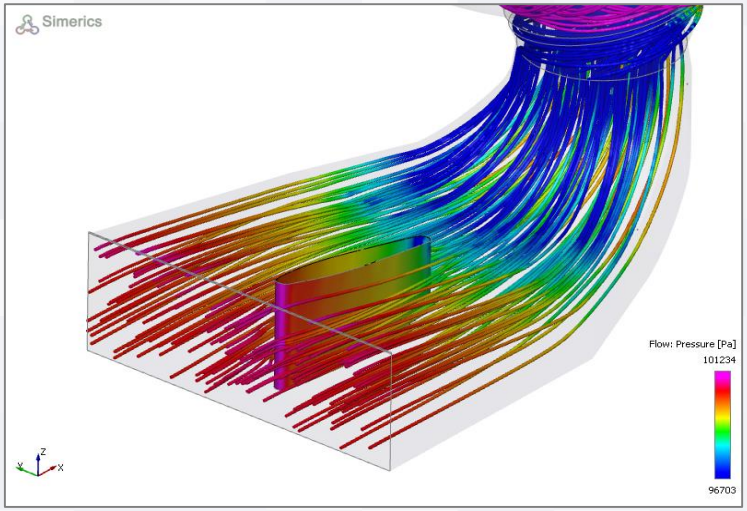
REQUIREMENTS FOR PUMP INSTALLATIONS WHERE FISH MIGRATION TAKES PLACE.

1. ENTRY OF THE PUMP
2. SPEED OF ENTRY RANGE
3. BALL PASSAGE OF THE IMPELLER
4. SPEED RANGE
5. impeller BLADE
6. RADIUS CUT WATER (TONGUE)
7. VOLUTE PRESSURE AND SPEED
8. FISH TEST
9. RESULT



1. ENTRY OF THE PUMP

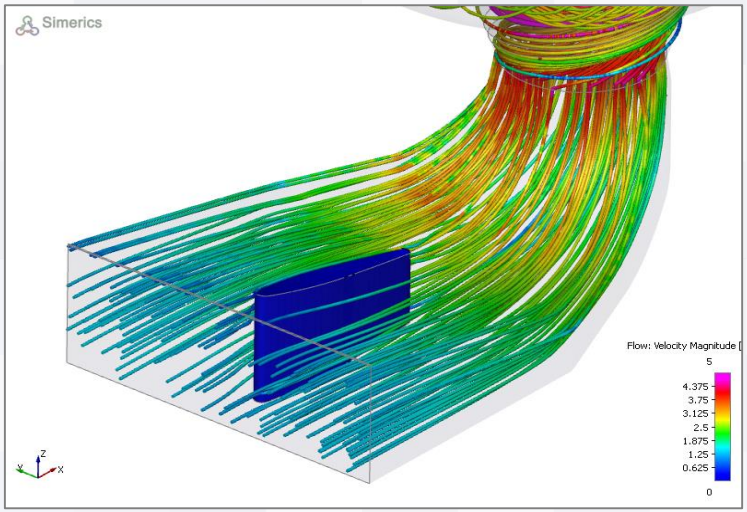
- Suction intake → - Equal flow
- Pump intake → - Pressure reduction
  - Higher flow



RESULT:

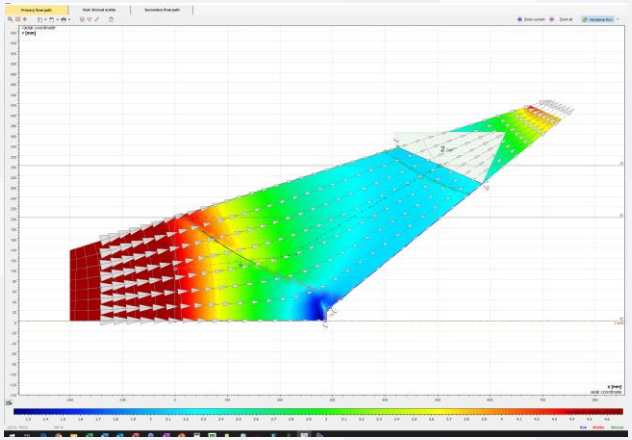
<u>Fishfriendly:</u> - Less damage and survival of the fish

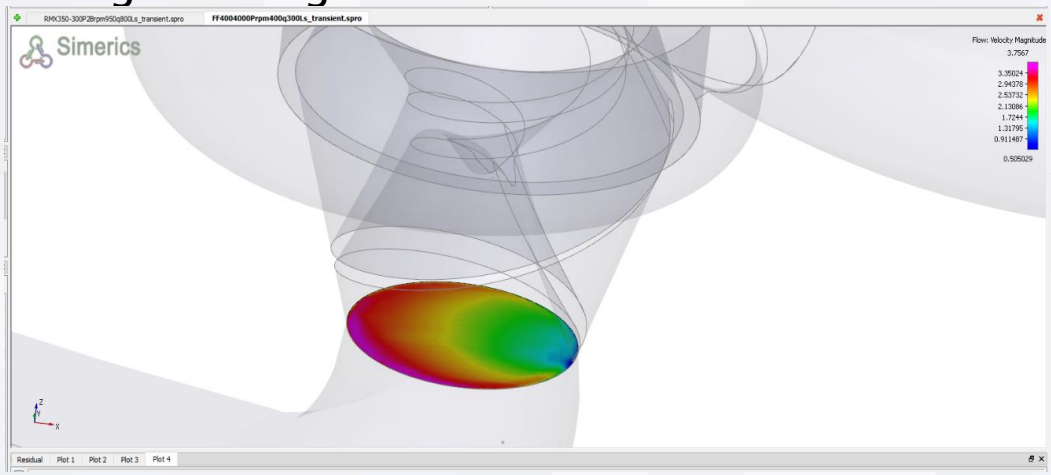
<u>Technically optimal:</u>
- Higher efficiency
- Less vibration
- Less cavitation

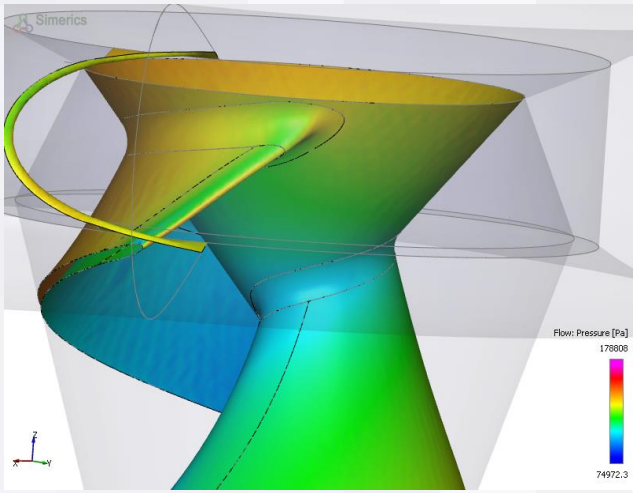


2. SPEED OF ENTRY RANGE

- The speed at which the liquid enters the impeller determines the further course in the impeller.
- By a more uniform velocity in the impeller, the transition of the impeller is in the volute, the design of the cut water gives a lot of attention.
- The outlet of the impeller must have an angle. This gives a smooth transition.

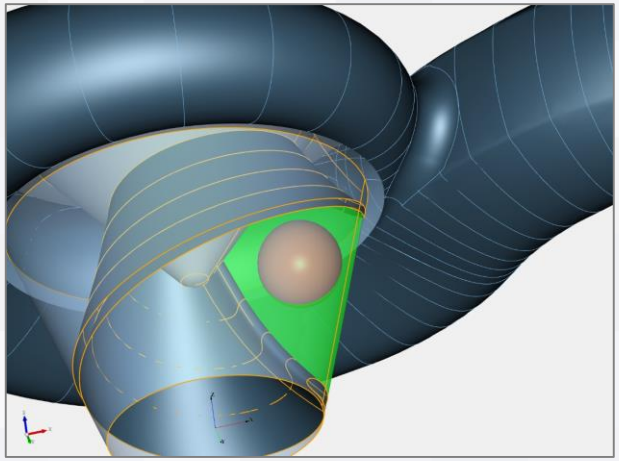






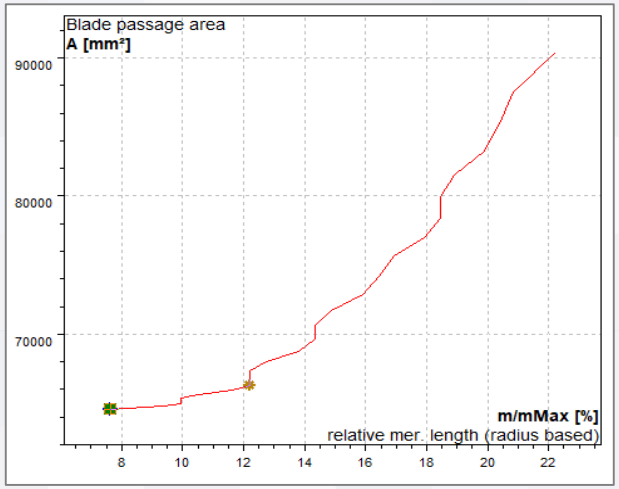
3. BALL PASSAGE OF THE IMPELLER

- Goal is: No back flow
  Capacity, rotating speed, shape and flow determine whether there will be back flow.



<u>Fishfriendly:</u>
- Maximum ball passage of the impeller
- Minimum number of blades

<u>Technically optimal:</u>
- Shape of the impeller
- Size of blade thickness
- Outlet angle and shape

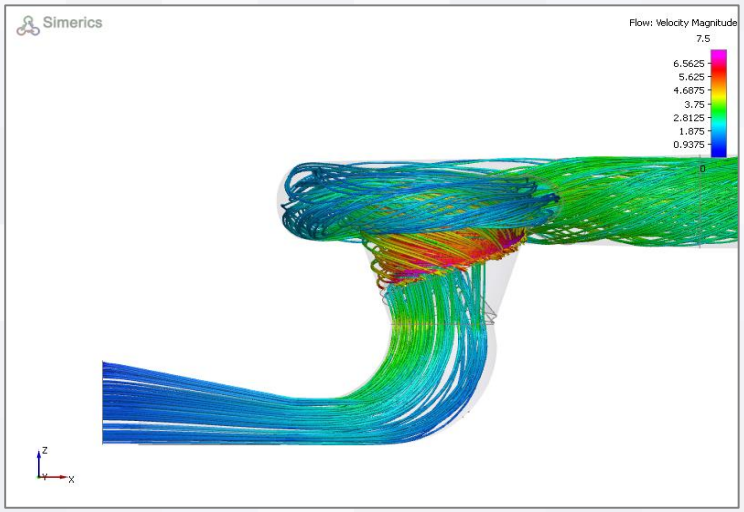


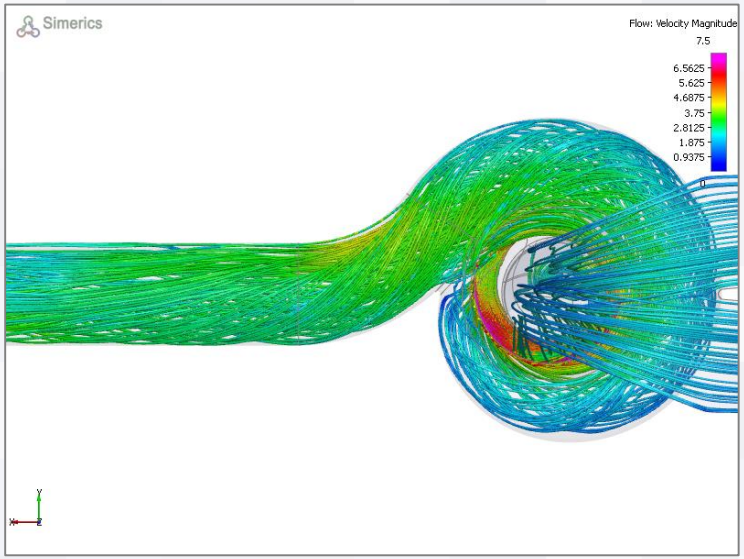
Blade passage: 64567 mm² Distance B2B: 280.1 mm
Max. sphere radius: 78.189 mm Distance H2S: 213.2 mm

Simerics provides for a conservative – yet true to life – simulation to proof this.

4. SPEED RANGE

- The speed of the impeller has a limit in relation to capacity and head.
- Capacity is usually the most important in a pumping station with little head.
- This for the speed below 400 R.P.M. and suction diameter of 400 mm, making the impeller diameter a determining factor. If the pump has a higher speed, the risk of damage or death of the fish, is greater with a small suction diameter.
- The traversing speed of the impeller should actually remain below 14 m / s.

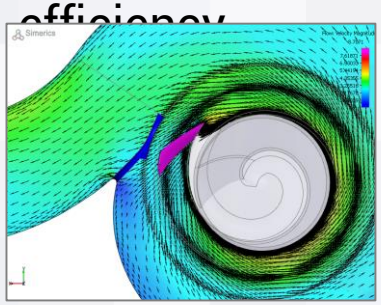


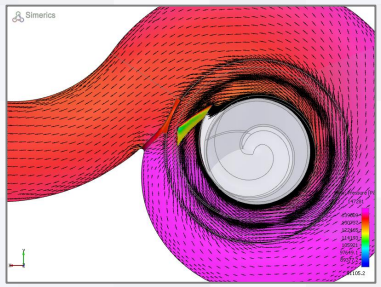


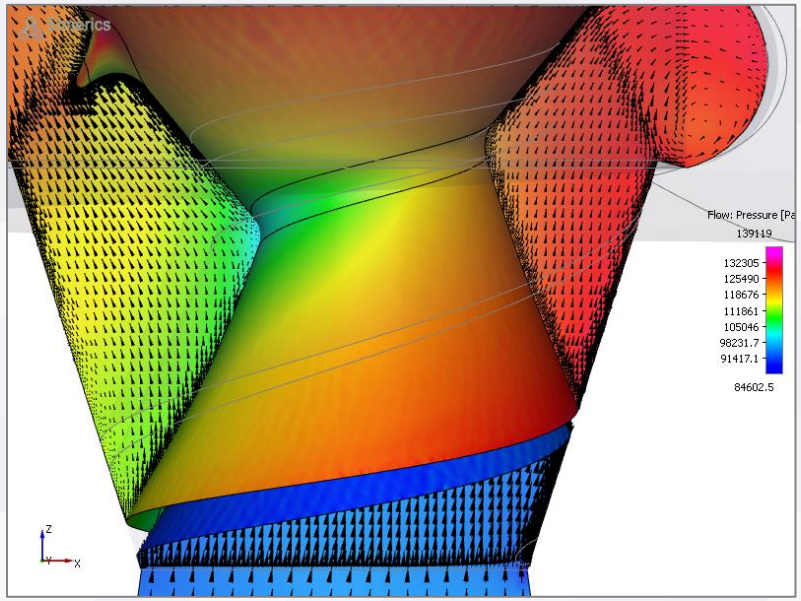
5. BLADE DESIGN

- The design of an impeller is the process of pressure and speed, without back flow. The hub shape is an important part.

- The thickness of the impeller blade must neither be too thin or too thick: If the impeller is too thin, the fish will be damaged. If it is too thick, it affects the efficiency

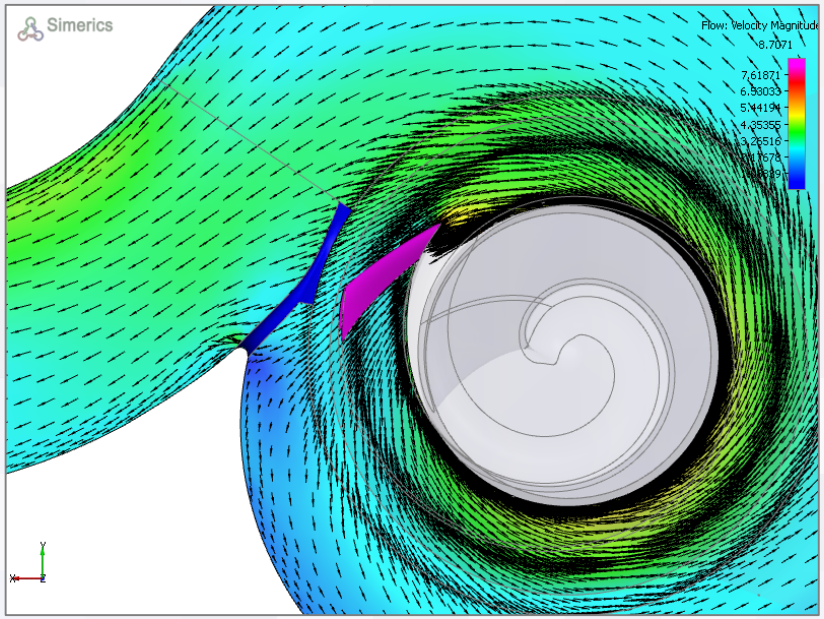


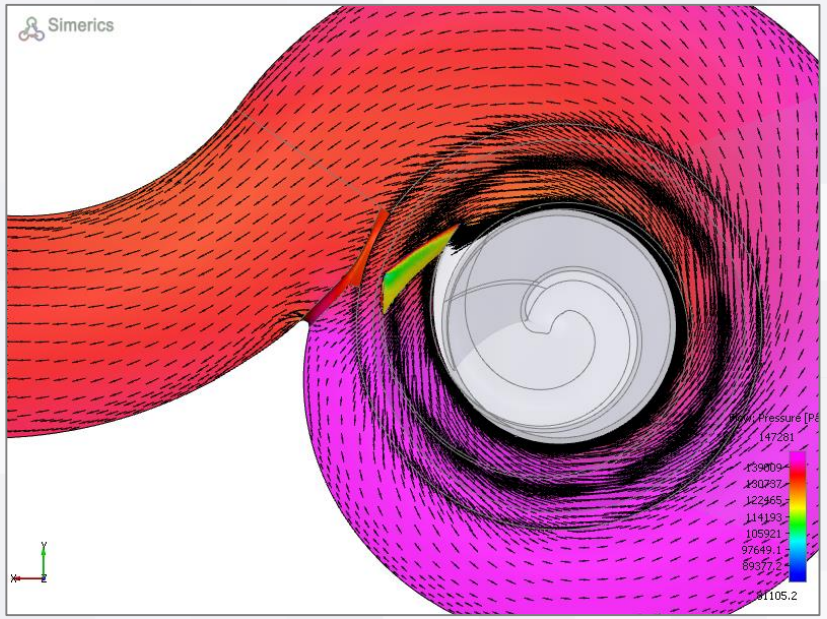




6. RADIUS CUT WATER (TONGUE)

- The rounding and geometry of the tongue is the part that takes place between the high and low pressure in the volute.
- The size of this rounding influences the driving rotation into volute spiral.

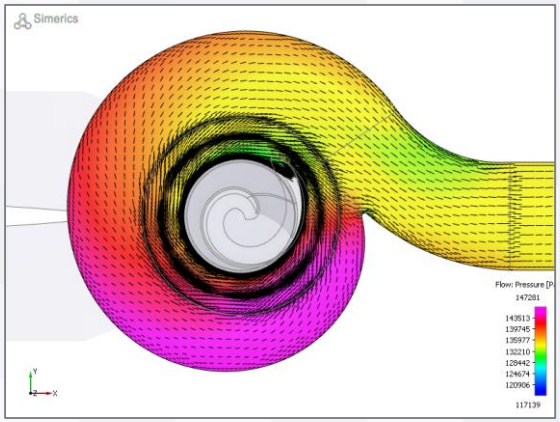


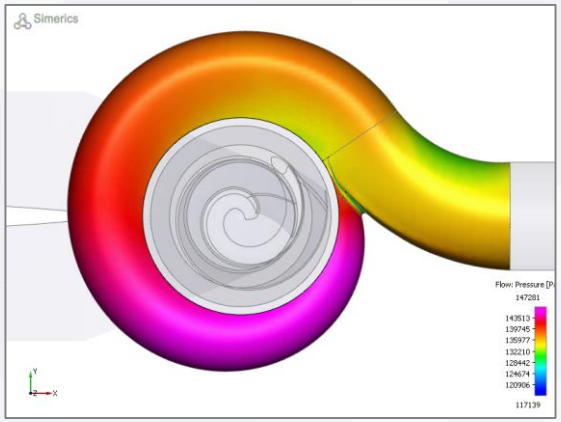


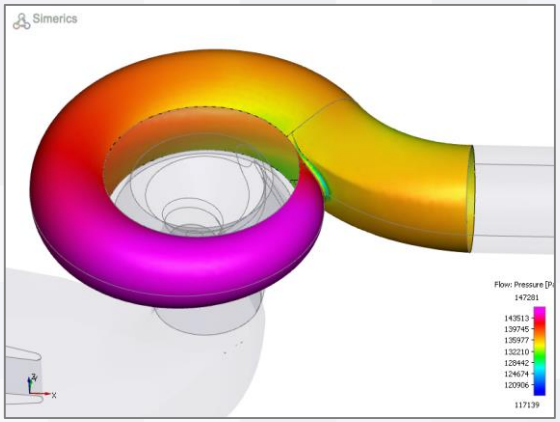
7. VOLUTE PRESSURE AND SPEED

- The pressure curve in the volute is a point where an equal pressure reduction must take place.

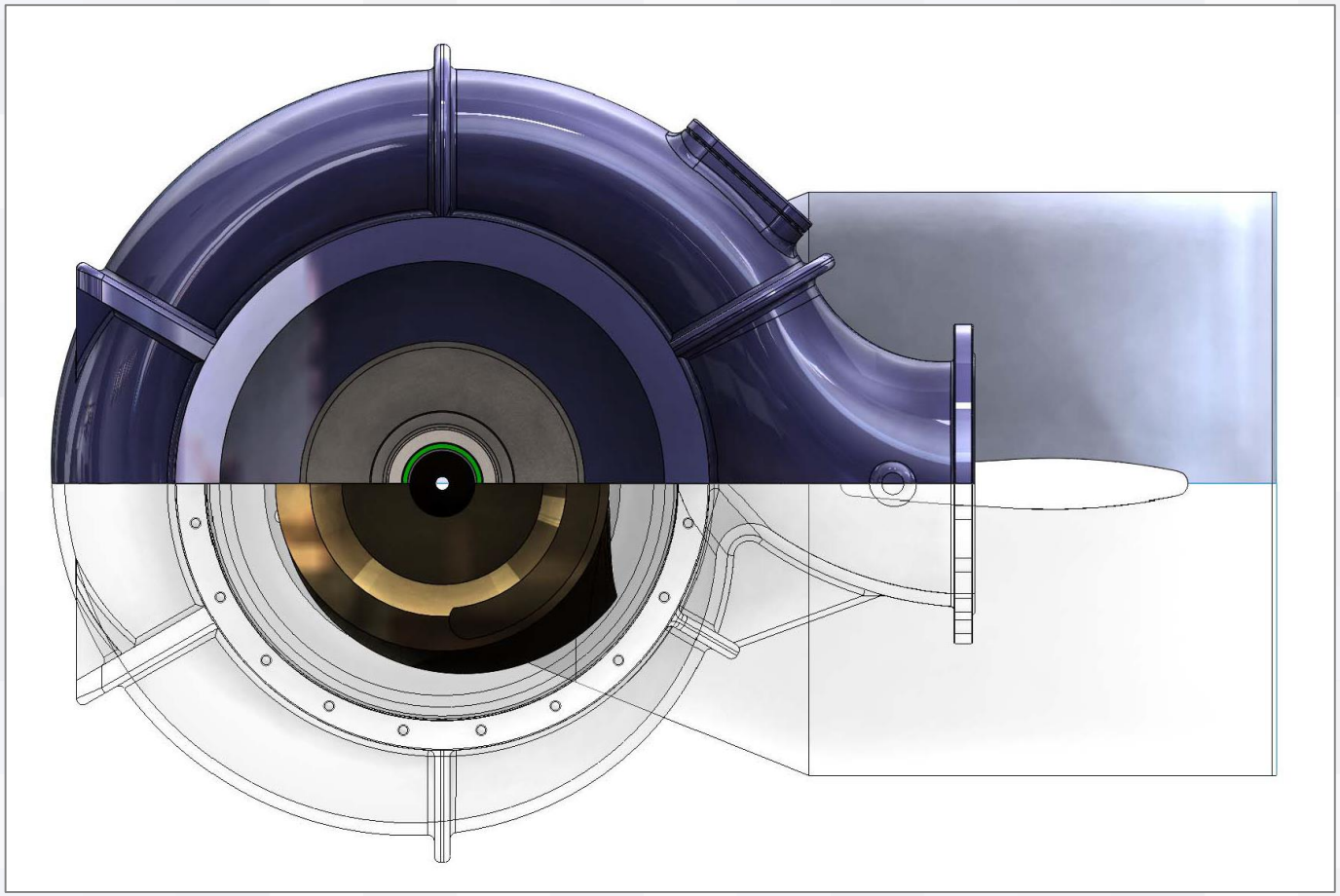
- The fish needs this in order not to damage the vesicles. If this does happen, the fish will die after some time.





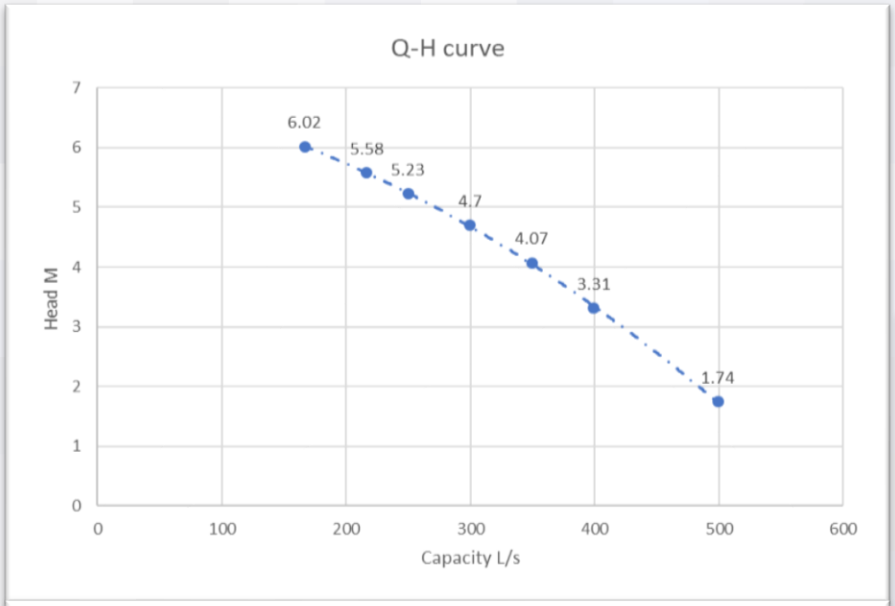


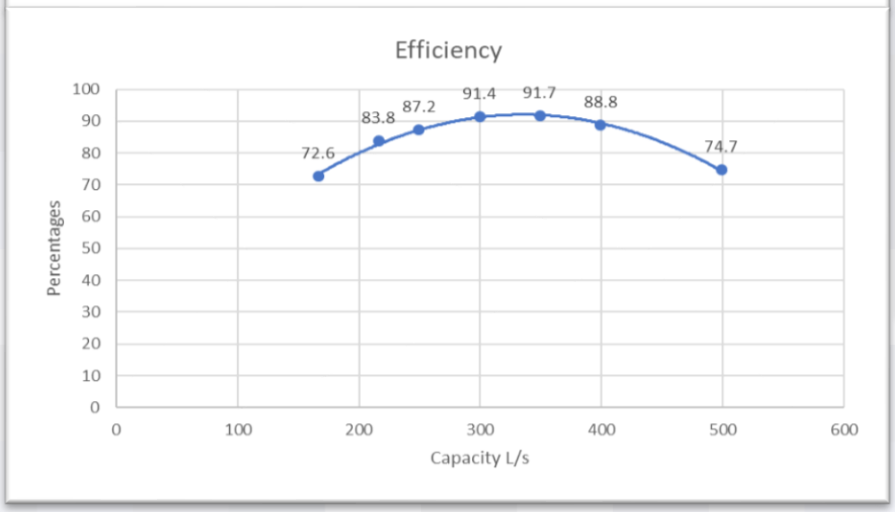
8. FISH TEST

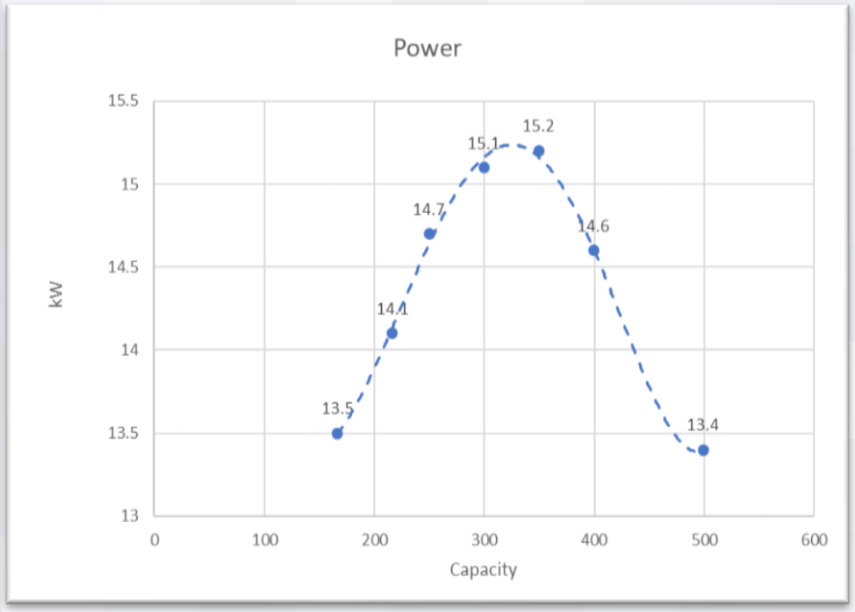


VIDEO

9. RESULT


Q-H curve
Head M
Capacity L/s
6.02
5.58
5.23
4.7
4.07
3.31
1.74


Efficiency
Percentages
Capacity L/s
72.6
83.8
87.2
91.4
91.7
88.8
74.7


Power
kW
Capacity
13.5
14.1
14.7
15.1
15.2
14.6
13.4