

# Your partner in the design and development of small turbines

Customised solutions for the manufacturers  
of small hydraulic turbines



Low, Medium and High heads

High and guaranteed performances – Optimal hydrodynamic behaviour

Reliability – Simplicity

# Mhylab – mini-hydraulics laboratory

Since it was created in December 1993, Mhylab has been developing turbines which satisfy the specific needs of small hydropower plants.

On the basis of projects that have been carried out, Mhylab supplies turbine manufacturers with customised solutions which allow them to offer their customers equipments having high and guaranteed performances. Moreover, the experience acquired by Mhylab allows it to offer engineering and consulting services specifically for small hydropower plants' equipments.

**Mhylab is independent of all manufacturers.**

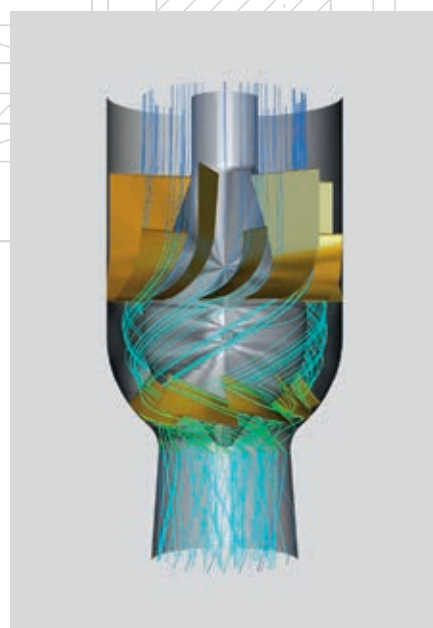
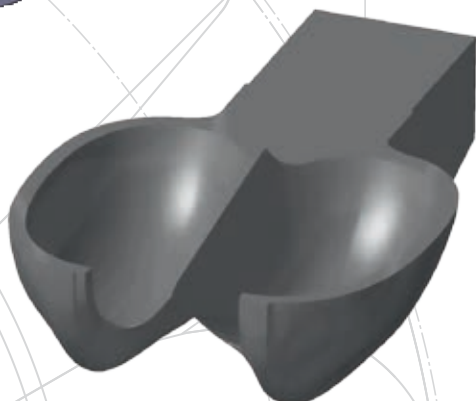
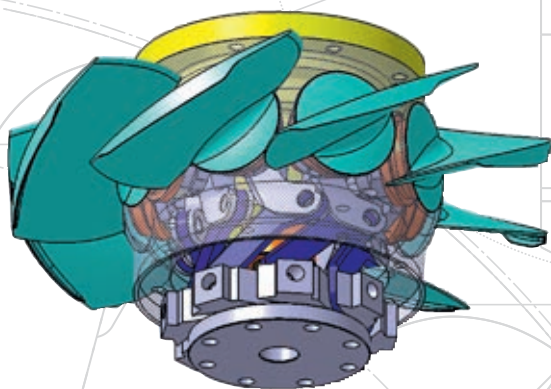
The hydraulic design of the turbines we offer is built on the following approach:

- **Resizing, simplifying, and adapting** the hydraulic techniques of large turbines.
- **Developments and model tests** in our laboratory.
- **Measurement of the impact produced by the adaptations and simplifications**, so as to optimize the manufacturing cost/performance ratio.

## Our services

From the plant data supplied by its customer, Mhylab will supply, on the basis of its model test results, all the information and plans necessary for the manufacturing of the turbine. These comprise:

- The **complete hydraulic profile** of the turbine (runner included).
- **Efficiency and mechanical output curves**, functions of discharge and net head.
- **Nominal and runaway rotation speeds**.
- **Hydraulic forces** on the turbine blades.
- **Maximum suction head** for reaction turbines.
- **Opening – discharge curves** for action turbines.



## Mhylab added-value

Mhylab is both neutral and independent, and has over the past 20 years developed a range of turbines' hydraulic profiles which cover a very wide range of applications:

- Heads: from 1.5 to over 700 m
- Discharges: from 10 l/s to 10 m<sup>3</sup>/s
- Outputs from 20 kW to 5 MW

**Operation and performance guarantees** afforded by Mhylab, based on the tests performed in its laboratory, represent a **real added-value** for both the manufacturer, and the future turbine operator.



Two-nozzle Pelton turbine on Mhylab's test rig

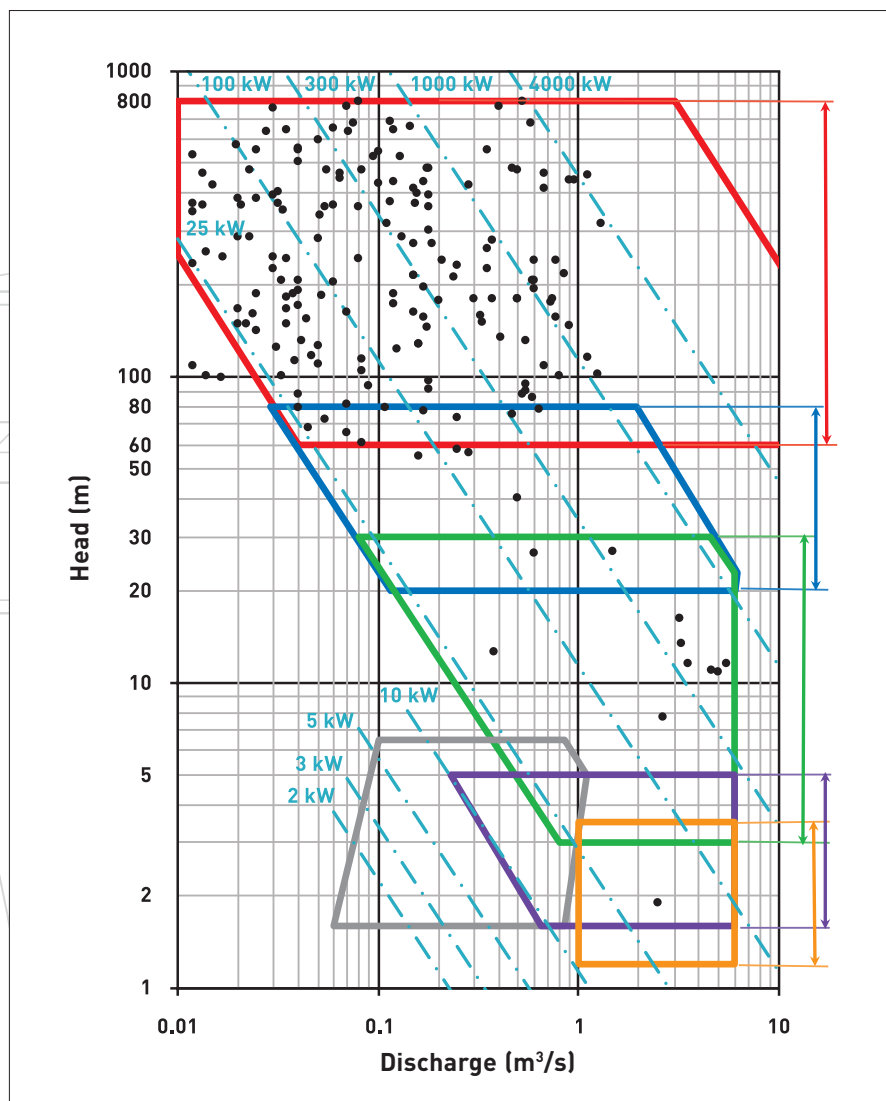


Saxo turbine on Mhylab's test rig



Spiral case turbine on Mhylab's test rig

### Range of Mhylab turbines



- Pelton
- Diagonal
- Axial
- Pico
- Very low head
- Siphon
- Mhylab references



# Pelton Turbine

The optimal solution for small, high-head, hydropower plants

Mhylab's expertise rests not only on laboratory tests, but also on the more than 190 turbines built so far on the basis of its designs.

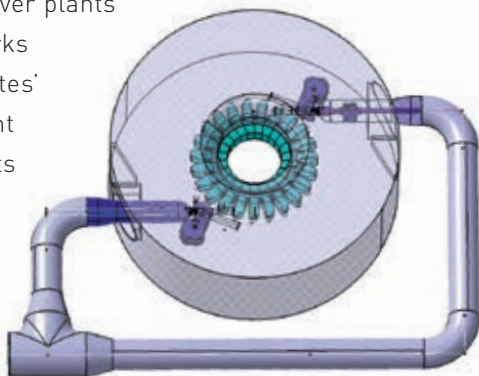
## Field of operation:

Net Head between 60 and more than 700 meters

Design flow between 0.01 and 5.0 m<sup>3</sup>/s

## A suitable solution for:

- Run-of-the river plants
- Water networks
- High-head sites' refurbishment
- Storage plants



## The Pelton turbine comes in the following configurations:

- Vertical or horizontal axis
- From 1 to 5 nozzles
- Comprising a manifold adapted to the project constraints (classic design or using standard parts)
- With the runner working in a casing at atmospheric pressure, or at back-pressure
- Using a single-block runner, or built with buckets mounted



## Examples of Pelton turbines manufactured on the basis of a Mhylab's hydraulic profile:



Haute-Pierre turbine (CH), 2 nozzles, back-pressure, integrated within a drinking water network (Q = 0.083 m<sup>3</sup>/s, Hn = 104 m, Pm = 76 kW)



Profray turbine (CH), 2 nozzles, on raw waste water (Q = 0.100 m<sup>3</sup>/s, Hn = 430 m, Pm = 380 kW)



La Gorge turbines (F), horizontal axis, 2 nozzles (Q = 0.900 m<sup>3</sup>/s, Hn = 440 m, Pm = 3490 kW)



Lauzet turbine (F), 2 nozzles (Q = 0.186 m<sup>3</sup>/s, Hn = 271 m, Pm = 431 kW)



Makayabaru turbine (Japan), 3 nozzles (Q = 0.730 m<sup>3</sup>/s, Hn = 176 m, Pm = 1132 kW)



Lafarge turbine (F), 4 nozzles (Q = 0.590 m<sup>3</sup>/s, Hn = 85 m, Pm = 435 kW)



Torrents de Verbier turbine (CH), 4 nozzles (Q = 0.500 m<sup>3</sup>/s, Hn = 475 m, Pm = 2077 kW)

# Diagonal Turbine (single or double regulation)

An optimal solution for small, medium-head hydropower plants

On the basis of computational fluid dynamics studies, and laboratory model tests, Mhylab has developed single and double-regulation variants having 8, 10, or 12 adjustable blades and several families of vanes, allowing a large range of discharges, heads and site constraints to be handled.

As an alternative to Francis turbines, these multiple configurations offer great flexibility with respect to variations in heads and discharges.

## Field of operation:

Net Head between 20 and 80 meters  
Design flow between 0.4 and 10.0 m<sup>3</sup>/s

## A suitable solution for:

- Run-of-the river plants
- Medium-head sites' refurbishment
- Water networks
- Environmental-flow plants
- Attraction flows for fish passes



8-blade scale model runner

## Single-regulated Diagonal Turbine:

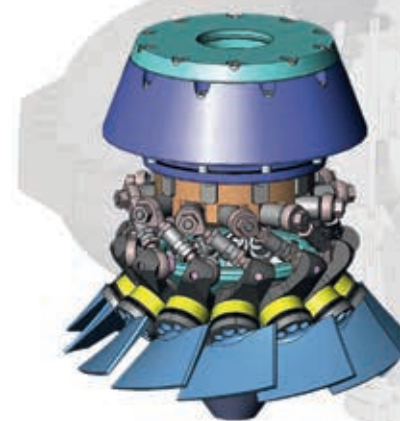
Saxo configuration — Vertical axis — Inclined axis — Horizontal axis — Fixed conic guide-vane system — Runner with adjustable blades:

- Provides various layout alternatives which require little lateral space.

## Double-regulated Diagonal Turbine:

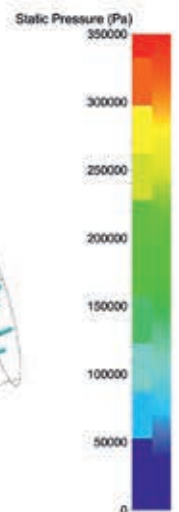
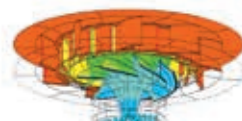
Cylindrical guide-vane system and spiral case configurations — Runner with adjustable blades:

- **Considerable flexibility** of the turbine with regards to variations in flow and head, thus allowing for the optimization of electricity production, and number of generator units.
- **Compact design.**
- Particularly **well adapted to refurbishment projects** for Francis turbine sites.



View of the model-runner's blade regulation system

Digital computation of flow



These developments have been performed with the support of Canton de Vaud, within the framework of its programme "100 millions for renewable energies and energy efficiency".

# Axial Turbine, Kaplan type

The simple solution for small low-head hydropower plants

## Field of operation:

Net Head between 1.5 and ~ 30 meters

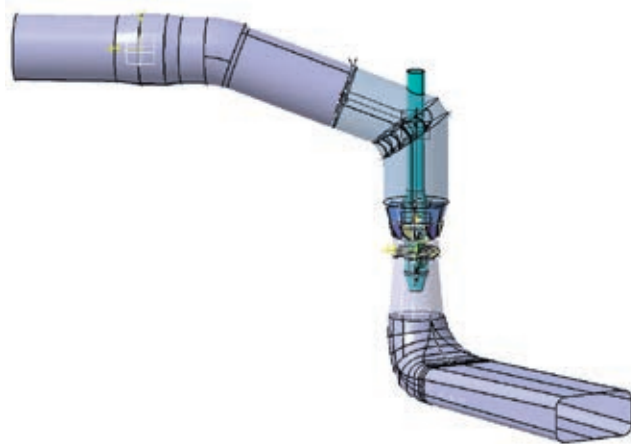
Design flow between 0.075 and 10.0 m<sup>3</sup>/s

## A suitable solution for:

- Run-of-the river plants
- Low-head sites' refurbishment
- Water networks
- Environmental-flow plants
- Attraction flows of fish passes

## Saxo turbine:

(3.0 to 30 m)



Small footprint, simplicity of construction, large working range, high efficiencies.

## Siphon turbine:

(1.5 to 5.0 m)

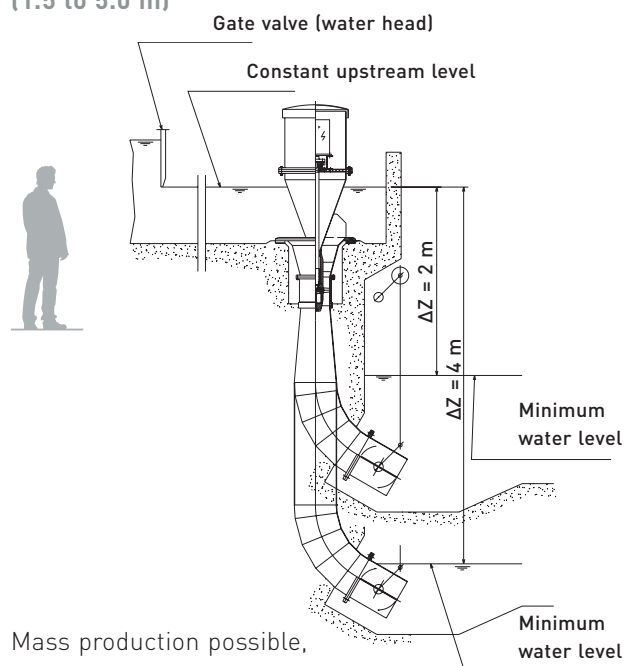
Simplified civil engineering works, possibility of using existing weirs, suppression of the safety valve.



UMV plant in Vallorbe (CH), siphon-type turbines  
(Q = 5.0 m<sup>3</sup>/s, H<sub>n</sub> = 2 m, P<sub>m</sub> = 85 kW)

## Pico turbine :

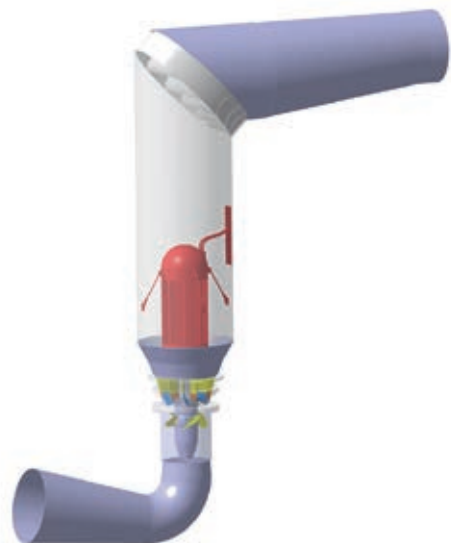
(1.5 to 5.0 m)



Mass production possible, reduced costs, can be adapted to every site.

## Bulb turbine:

Immersed generator, ease of site integration.





Examples of axial turbines, Kaplan type,  
built on the basis of a Mhylab's hydraulic profile:

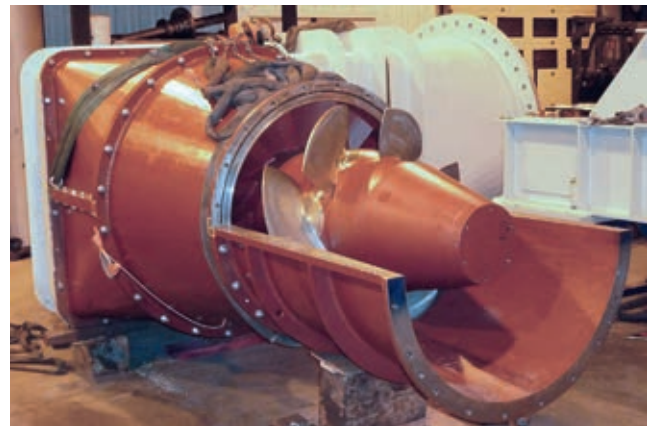
Oust (France)

Shinsogi (Japan)



Bulb turbine  
( $Q = 5.5 \text{ m}^3/\text{s}$ ,  $H_n = 11.5 \text{ m}$ ,  $P_m = 495 \text{ kW}$ )

Axial Turbine, horizontal axis,  
uses Arezzo drinking water  
( $Q = 0.380 \text{ m}^3/\text{s}$ ,  $H_n = 12.5 \text{ m}$ ,  
 $P_m = 42 \text{ kW}$ )



Axial Turbine, vertical axis  
( $Q = 3.2 \text{ m}^3/\text{s}$ ,  $H_n = 16 \text{ m}$ ,  $P_m = 456 \text{ kW}$ )

Poggio Cuculo (Italy)



## Kaplan Turbine

An optimal solution for low heads

Mhylab is at present developing a configuration of Kaplan turbines with spiral case and cylindrical guide-vane system, similar to that of Diagonal turbines.

### Field of operation:

Net Head between 2 and 30 meters  
Design flow between 0.5 and 30.0  $\text{m}^3/\text{s}$

### A suitable solution for:

Low-head sites where discharges and/or heads vary: run-of-the river plants, water networks, refurbishment of low-head sites, environmental-flow plants, attraction flows for fish passes.

### Advantages:

- Horizontal or vertical axis configurations.
- For small turbine manufacturers:

A **unique** mechanical concept that covers a **wide range of heads** with two types of runners (Kaplan and Diagonal).

- For the operators:

Kaplan turbines designed and adapted **specifically to small-hydro situations**, with performances guaranteed by model tests.

These developments have been performed with the support of Canton de Vaud, within the framework of its programme "100 millions for renewable energies and energy efficiency".

Mhylab also is:

## Your service provider in small-hydro engineering

Mhylab is in a position to offer a complete range of services including in particular:

- **Feasibility studies and preliminary design** in view of analysing the various possibilities offered by a site, and assessing their potential technical and economic advantages.
- **Tender design projects**, where the choice resulting from a feasibility study is fully analysed in view of its execution.
- **Call for tenders' procedures**, for which Mhylab, which is independent of all manufacturers, offers expert advice.
- **Project monitoring, assistance with the acceptance of equipment, and commissioning**, phases during which Mhylab's activity guarantees the quality of the project, from the onset of planning to the final acceptance of the plant.
- **Site assessment and potential identification studies** on a given territory.
- **On-site tests**, in view of determining the characteristics of an existing system.
- The **writing of brochures and technical documents** relating to small hydro.
- The **design** of hydro-mechanical devices such as by-passes, Carnot pressure reducers, etc.
- **Punctual advice** to operators and project designers.
- **Technical expertise.**

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### An expert laboratory:

Using the experience it has acquired in performing laboratory tests, Mhylab is willing to perform model tests for third parties.

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