

Development of innovative fog-harvesting devices and their application in architecture and built environment

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WATER ISSUE

In order to face the hydric crisis and preserve global water supplies, relieving the stress upon conventional and over-exploited fresh water sources, fog harvesting stand as a promising yet relatively unexplored solution. Fog collector is a pre-Columbian device, able to condense atmospheric water on its textile surfaces; in some arid regions it can be the main source of water. Despite its promising capacity, its shape, components and materials didn't change since ancient times; therefore the collection efficiency hasn't improved much. Fog collectors are composed of structure and mesh, these can be studied and developed, in order to optimize their collection performance, to improve the hydric conditions of specific climatic regions, and making them water self-sufficient.

FOG HARVESTING

Some areas of the world are characterized by intense fogs, defined *oasis de niebla* (fog oasis or *lomas*). Some of them are located in the most critical hydric conditions areas, while others in territories that will face this hydric struggle in the next years, due to climatic changes and anthropic demand. Since ancient times, in these oasis we can see the development of several techniques to exploit the phenomenon and produce water, these fog collectors are called *atrapanieblas*. They are a tensile-textile structure, vertically developed, made of a mesh and supporting poles and cables. Generally, fog collector can be divided in two main types: bi-dimensional and three-dimensional. A further subdivision depends on the type of anchoring of the mesh to the structure; in fact, there are those with a rigid structural support frame or the tensile-structures. Although various types of *atrapaniebla* have been tested over the time, the model most applied worldwide remains the Chilean type (by Fog Quest); it is a bidimensional structure with the employment of Raschel mesh. Nowadays, fog collectors are low tech devices and fog harvesting projects are commonly developed in arid areas for agricultural and reforestation purposes.

The challenging requirements for fog collectors concern:

- a) the mesh efficiency, in relation to the phenomena characteristics and environmental durability;
- b) the structural shape, regarding exposition, wind flows and resistance;
- c) the study of biomimetic solutions for a smart fog collector design.

THESIS PROPOSAL

We are proposing four main aspects for the development of a fog harvesting technology, the students are free to discuss with the supervisors which are the topics in which they are more interested in, in order to customize the thesis.

1. Location: Milan, Canary Islands, Portugal, Africa, India, Middle east, South America. (Just one of them, where you can locate a fog oasis).
2. Context: Urban, Rural, Emergency
3. Application field: Building's façade, Tents, Installations
4. Components development: mesh, structure, bio-mimetic design, bio-based design.
5. Test campaign: in the lab (Textiles HUB), in the field (Milan)

The thesis is both research and design based, first we will define the objectives, then the students will study the state of the art, develop a test campaign and on the results obtained they elaborate a project proposal. The outcome, can be a smart textile façade to be applied in urban environment, a shelter for emergency camps or an installation for public spaces. Basing on the location and on the application field, the test campaign should be developed in the lab or-and in the field. In TextilesHUB we can provide the students the use of different types of meshes, a climatic chamber and a humidifier, moreover we can discuss the use of a wind tunnel and other equipment. For field tests, we allow the students to install some selected meshes on the rain-fog box, it is structure installed in via Golgi, there they can test fog harvesting performance in a urban environment.

Bio-mimetic approach refers to research on natural systems that harvest water from atmosphere. In fact, many species of arid and semi-arid climates developed smart solution for harvesting water in extreme conditions, that can possibly be applied in a biomimetic project design. Along with the bio-based approach that refers to the study of natural fibers and materials that can be applied in the design of this innovative system (mesh and structure) enhancing it to a nature-based solution.

TIMING

The development of each thesis should be approx. of one semester, we can discuss more in detail about the time-line when the main objectives of the thesis have been defined. The students that want to develop a field test campaign must take into account the presence of fog in Milan; therefore for them the “working months” are: October, November, December, January and February. Regarding the lab tests, those can be developed at any time.

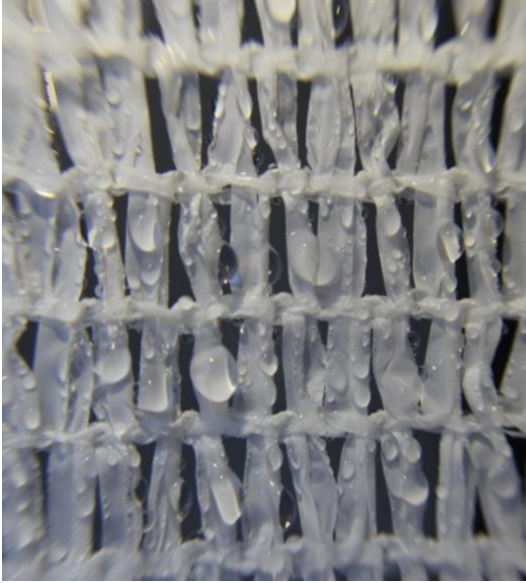
SOFT-SKILL REQUIREMENTS

We are looking for curious and passionate students, since the thesis require an innovative approach some investigation must be developed. Fog harvesting is a multi-disciplinary subject, therefore the students will come close to studies about climate, geography, chemistry and structure/architecture. Moreover the students should manage some software (Rhino, Grasshopper, Excel, GIS), however they are not mandatory. The students are not supposed to be experts on chemistry or geography, they will be guided by the supervisors.

Nº OF STUDENTS: 3

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Example of a mesh tested in lab



Example of a mesh tested in Rain-Fog Box