Request for **industrial partners** (June, 9th, 2017)

**Project title:** Alternatives To chemical TReAtment techniques for Cooling Towers

**Acronym:** ATTRACT

<table>
<thead>
<tr>
<th><strong>Project ID</strong></th>
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<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Collective research (VIS-CO)</td>
</tr>
<tr>
<td><strong>Period</strong></td>
<td>1-2 years</td>
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<tr>
<td><strong>Starting date (indicative)</strong></td>
<td>January 2018</td>
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<tr>
<td><strong>Total project budget (€)</strong></td>
<td>TBD</td>
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<td><strong>Total man months</strong></td>
<td>TBD</td>
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<tr>
<td><strong>Subsidy percentage</strong></td>
<td>80% of total project budget</td>
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<td><strong>Amount of subsidy (€)</strong></td>
<td>TBD</td>
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<td><strong>Coordinator</strong></td>
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<td><strong>Industrial partners</strong></td>
<td>Current partners not disclosed at the moment</td>
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<td><strong>Executing Partners</strong></td>
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**Project description**

**Introduction**

Cooling towers and cooling water systems are an integral part of process operations in many industries, as they provide cooled water for applications ranging from heating, ventilation, air-conditioning, and industrial processes. Cooling involves the transfer of heat from one substance to another. The substance that loses heat is said to be cooled, and the one that receives the heat is referred to as the coolant. All cooling systems rely on this 'give and take action', with water being the most widely used coolant.

Cooling water used in cooling towers is treated to promote an efficient transfer of heat and to protect the cooling system so as to overcome a number of adverse effects on the performance of the cooling equipment. The adverse effects are strongly related to the chemistry of the water (e.g. conductivity, pH, alkalinity, and hardness) taken in for cooling and the way the cooling system is operated (e.g. cycles of concentration).

In general, there are three major issues an industrial cooling water system may encounter: corrosion, deposition/scaling, and microbial growth:

- **Corrosion** of cooling water equipment leads to metal loss that can result in critical system failures in heat exchangers, recirculating water piping, and process cooling equipment. Corrosion also results in a loss of efficiency (as corrosion products precipitate on heat transfer devices, insulating the metals) and eventually may also lead to leakage and spills.

- Cooling towers are also vulnerable to a variety of contaminants that cause **deposition/scaling**, predominantly by precipitation of calcium carbonates, sulphates and phosphates, Zn and Mg. Deposition interferes with heat
transfer, increases corrosion rates, restricts water flow, and causes loss of process efficiency and production.

- Biological organisms, including algae, bacteria, protozoa, and fungi, often find their breeding grounds in cooling towers. For instance, the conditions in cooling towers can be ideal for the growth of the infectious proteobacteria *Legionella pneumophila*, which is present in low concentrations in most water supply systems. The exhaust air from a cooling tower contains fine droplets of water, called mist, that can drift with the exhaust air away from the cooling tower in a plume. If the cooling tower water has developed a *Legionella* growth, the mist will also contain the infective bacteria. In addition, if not properly controlled, biological growth forms and acts as a natural adhesion surface for scale formation, resulting in fouling, which can lead to blockage of the heat exchanger tubes or to emissions to air from cooling towers.

If not properly controlled, these problems can have a direct, negative impact on the value of the entire process or operation. As such, all of these conditions can be seriously problematic when it comes to optimising the efficiency of a cooling water tower or system.

As a consequence, a wide range of cooling water chemicals is used to provide protection against these cooling system challenges:

- **Chemical inhibitors reduce corrosion** by interfering with the corrosion mechanism. Inhibitors usually affect the corrosion reactions at either the anode or the cathode. Commonly-used anodic inhibitors (that establish a protective film on the anode) include molybdate, orthophosphate, nitrite and silicate, while commonly-used cathodic inhibitors (that form a protective film on the cathode) include phosphino succinic oligomer (PSO), bicarbonate, polyphosphate and zinc.

- **Threshold inhibition chemicals prevent scale formation** by keeping the scale-forming minerals in solution and not allowing the crystallisation process to begin. Kinetic inhibitors modify the crystal structure of scale, which significantly reduces the speed of growth of deposit. When new crystals are formed in solution, dispersant polymers can prevent deposition by keeping these particles suspended in the same manner as preventing fouling. Organic phosphates, polyphosphates, and polymeric compounds can act as both threshold inhibitors and kinetic inhibitors.

- **Three general classes of chemicals are used in microbial control:**
  1. **Oxidising biocides**: These biocides oxide important cellular components in microorganisms, resulting in death of the organisms. Chlorine is the traditional oxidising biocide used most widely in cooling towers, often through application of liquid sodium hypochlorite (bleach) but occasionally with gaseous chlorine or other forms.
  2. **Non-oxidising biocides**: Non-oxidisers perform differently than oxidisers. They are organic compounds that react with specific cell components within a microbe to ultimately destroy that cell.
  3. **Biodispersants**: Biodispersants do not kill organisms. They loosen microbial deposits, which upon detachment from a metal surface, are flushed away with the bulk cooling water. They also expose new layers of microbial slime or algae to the attack of oxidising biocides. In addition to removing biodeposits, biodispersants are also effective in preventing biofilm formation from taking place.

The wastewater from cooling systems is often discharged to stormwater drainage systems or surface waters that flow into wetlands, rivers, estuaries and other water bodies. The discharge of cooling tower wastewater poses the following contamination risks:
• Biocides and anti-corrosion chemicals can be toxic to humans and also to plants and animals in aquatic environments.
• Biocide and anti-corrosion chemical residues discharged to sewer may be toxic to the microbes used for sewage treatment.
• Sediment can cause turbidity problems in waterways and water bodies.
• Heavy metals (additives or scoured from pipe-work) are toxic and can accumulate in aquatic organisms.

The character and level of emissions to the environment are not only a result of the applied cooling tower configuration, but to a large extent depend on the way the system is operated and the way in which the resources that are needed to operate a cooling system are being managed.

Goal
During recent years, the emissions caused by cooling water discharge has come under increasing scrutiny from an environmental point of view and as a result, cooling water management needs to change. Therefore, focus needs to be put on measures to reduce the amount and the impact of emissions due to the application of cooling water (additives):
• by reducing corrosion of cooling equipment;
• by reducing leakage of process substances into the cooling circuit;
• by applying alternative cooling water treatment;
• by selecting less hazardous cooling water additives;
• by optimising application of cooling water additives.

Reduction of emissions due to cooling water treatment should aim at reducing the need for treatment (prevention) and at selection and optimal application of additives (pollution control) within the requirement of maximum heat exchange. Currently, new techniques/alternative chemicals for cooling water treatment are available, but it is unclear to the end user which of these techniques/chemicals offer true potential.

The main goals of this project are to demonstrate and benchmark available technologies/alternative chemicals that can provide protection against corrosion, deposition/scaling, and microbial growth and that will impose less environmental (health) hazards. In the envisioned project, different alternatives will be demonstrated first in relevant, lab-scale test equipment and later on in relevant, industrial environments. To this aim, one (or more) independent scientific partners will compare the available, alternative techniques using certain criteria (including sustainability, efficacy, and cost). In addition, we will also focus on the scalability of the selected techniques to assess their relevance in an industrial environment, and on legislative issues.

Request
Catalisti aims to initiate and setup a Collective Research (VIS-CO) project on alternatives to chemical treatment techniques for cooling towers. The main goal of this Collective Research is to build up knowledge & know-how in view of evaluating future opportunities for local companies and for the region in general. The results that originate from the envisioned collective research will lead - in the short or long term - to economic added value at the companies. This can be achieved by innovations, new developments, optimization of processes/products/services and implementation of the obtained results at the target companies.
Apart from the above, the results of the research will be spread throughout the target grouping of companies by suitable measures (e.g. presentations, conferences, training, etc.), and there will be a technical and legal path for technology transfer to all interested companies without discrimination.

**To setup a consortium of companies, Catalisti is searching for industrial partners that are interested to actively participate in the project and that want to contribute with a specific (business) case. Companies not active in the chemical sector can express their interest to participate as well.**

The envisioned Collective Research project will receive funding by Catalisti (and by the participating sector federations) of at most 80% of the acceptable project costs. The participating companies are expected to financially contribute to the remaining 20% of the project budget.

**How to reply to this request**

Please send an e-mail before June, 23rd, 2017, to lvanginneken@catalisti.be, and briefly describe your interest and potential contribution to the project. After indicating your interest in participation, you can be contacted by telephone to further elaborate your contribution to the project. The final decision whether or not the project will be further developed and finally submitted to VLAIO will be communicated the latest on June 28th, 2017. This will depend (among others) on how many companies have expressed their interest in participating in the project. Please contact Luc Van Ginneken (lvanginneken@catalisti.be; (+32)(0)477/97.99.47) for any further question you might have related to this request.

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END OF RFP