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# Development of a System for Recovering Heat from the Water Used to Reduce the Temperature of the Fumes Outgoing from an Electrofilter

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**Abstract**

The project "DEVELOPMENT OF A SYSTEM FOR RECOVERING HEAT FROM WATER USED TO REDUCE THE TEMPERATURE OF THE FUMES OUTPUT FROM AN ELECTROFILTER" by the Company RTP RIFINZIONE TESSILE PRATESE SRL, developed in 2018, is placed in an extremely innovative context; in fact, both for the specific structure and corporate philosophy of the Company, linked to innovation, a new innovative product has been created in accordance with the criteria set out in the Oslo and Frascati manuals. As can be seen from the experimentation, the elements of innovation are linked to various components that have determined a series of preliminary studies and tests for their operation. The innovative elements are enclosed in various specific components that are listed below as an example:
R.T.P. S.r.l. Rifinizione Tessile Pratese is based in the Municipality of Vaiano (PO) in via G. di Vittorio 46, and is a textile company that operates in the field of “finishing” of fabrics. Finishing in the textile field consists of the set of operations performed on a fabric to improve its appearance, to give it particular qualities of comfort or wearability, or to make it more suitable for the purposes for which it is intended. In particular, a significant part of the operations carried out by R.T.P. S.r.1. consists of washing and drying treatments of fabrics, activities for which the optimization of energy consumption has enormous economic relevance.

R.T.P. S.r.l. has therefore designed and developed a system for recovering the heat of the water used to reduce the temperature of the fumes exiting an electrofilter.

**Keywords**: Sustainability, Energy, Prototype, Water recovery

## 1. Introduction

The dissemination and transfer of the results obtained were conducted in line with the guidelines of the Frascati Manual, ensuring that all sensitive information and know-how developed during the research and testing phases were carefully protected and only partially shared to safeguard the company's competitive advantage. Throughout the project life cycle, the Company rigorously and methodically documented each phase of the technological development processes, collecting evidence in the field through detailed reports and technical sheets, which were integrated into a comprehensive document attached to the final report.
Furthermore, the internal dissemination plan of the project was oriented to maximize the appropriation of the skills developed by the technical team and management resources, enabling a continuous application and optimization of innovative technologies for an environmentally sustainable process. This strategy made the company more competitive, capable of quickly responding to the challenges of the sector and fully exploiting the technical innovations acquired.

## 2. Materials and methods

Inside the company R.T.P. S.r.1. there is a processing section consisting of machines called “ramose” (commonly called “stencils”) that are used in textile finishing for drying fabrics after washing or other wet treatments. The “stencil” is made up of a metal chamber that is thermally insulated and heated by means of appropriate radiators; the hot air needed for their operation is obtained by heating the external air.
The exhaust from this type of machine therefore consists of fumes that contain the residues of the oils and sizings released by the fabrics during heat fixing, and must therefore be treated before being released into the atmosphere. For this reason, a few years ago the company equipped itself with a purifier (electrofilter) that, through condensation/electrofiltration operations, reduces the pollutants present in rivers.
Since this type of electrofilter, during normal. operation, uses water to lower the temperature of the exhaust fumes, has hot water as the output fluid (60-70°C). To recover the heat present in the exhaust water, at the time of installation of the electrofilter, a system was created which - using a heat exchanger having as input fluids the external air supplying the "stencils" (which is therefore heated) and the hot water exiting the electrofilter (which cools down) - has allowed a reduction in the fuel consumption necessary for the activity of R.T.P. S.r.l.

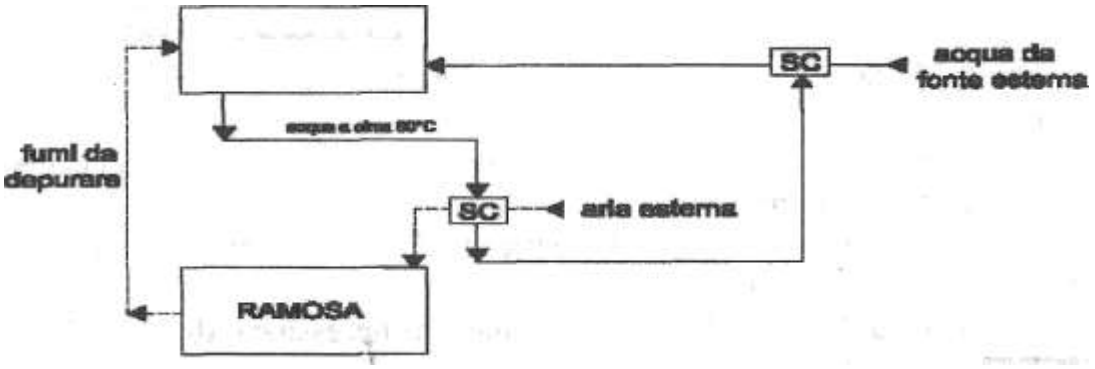


**Figure 1**. Description of process ex ante

When the electrofilter works at maximum capacity, it can discharge up to 5-6 m3/h of hot water; this flow rate is far more than that needed to preheat the air entering the "stencils", thus being forced to recirculate it towards the electrofilter, after being adequately cooled by water from an external source. This resulted in an obvious "waste" of the heat contained in it.

A heat recovery system contained in the electrofilter waste water was therefore designed — and subsequently built — during 2018, capable of serving other machines in the company that require — for their operation — a hot fluid.

The main problem to be addressed was to keep the heat of the electrofilter waste water as high as possible for as long as possible, so as to have it available at a sufficient temperature (or very close to) that necessary for the proper operation of other machines in the company. The idea was to use the excess amount of hot water in the machine used for the so-called "wide-area washing"; this treatment requires - depending on the fabric to be washed - water at various temperatures (cold water, water at 40/50°C and water at 60/70°C).

A new heat recovery system was therefore first designed and then built, described by the following main sections:

• transport of the water exiting the electro-filter to an underground tank positioned under the "stencils";

• autoclave that sends the hot water to the machines that require "heat" for their operation, specifically to the "stencils" themselves (as was already the case for the existing system before the intervention) and to the "wide-area washing" machine. In addition - if the available hot water flow rates allow it - the possibility of using the excess hot water for heating the rooms during the winter period was also envisaged;

• installation of a sufficient number of heat exchangers to make the entire heat recovery system functional and efficient.

At the end of the works, the system was as summarily represented below:

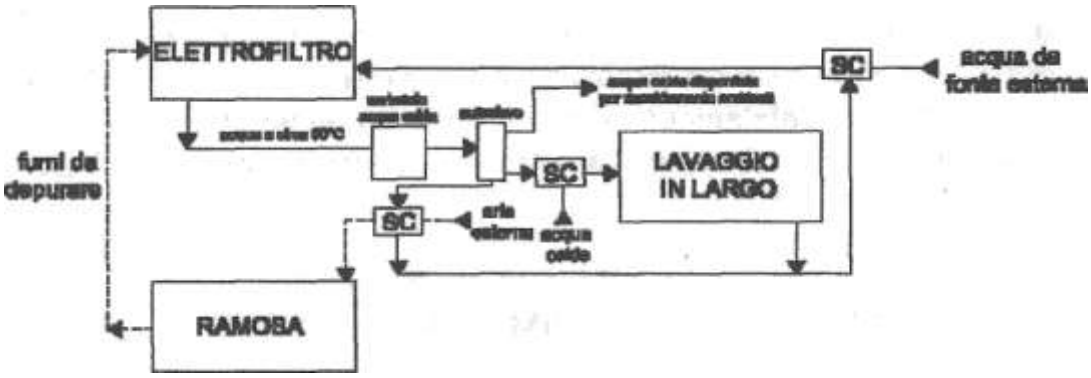


**Figure 2**. Description of process ex post

## 3. Results

During the activity, it was found that it was possible to maintain the temperature of the hot water inside the tank located under the “stencils” at about 50°C, and that the water was able to reach the machine used for “wide-area washing” at about 40°C in quantities (in terms of flow rate) sufficient for its correct operation. In this way, it was necessary to use small quantities of fuel only if the machine had to be used at a machine temperature of 60/70°C.
As regards the “stencils”, the efficiency remained similar to that obtained with the configuration of the heat recovery system created at the time of installation of the electrofilter.
At times of maximum electrofilter performance (production of hot water at 60/70°C with a flow rate of 5-6 m3/h), the company even managed to use part of the hot water to heat the rooms in the winter, thus achieving the maximum expected objectives.
R.T.P. S.r.l. has therefore managed to drastically reduce — even compared to what was done previously — the fuel consumption necessary for the company's activity. In fact, the quantities of hot water coming out of the electrofilter (both in terms of flow rate and temperature) have often been sufficient to completely meet the energy needs of the "stencils" and the machine used for "wide-area washing", and can sometimes be used for heating the rooms.

## 4. Conclusion

The Company’s project involved the creation of a team selected with rigor and attention to the skills needed to tackle an advanced experimentation process in the Company’s reference sector. The company chose its personnel with a precise assessment of their operational and theoretical skills, favoring people with decision-making ability and in-depth knowledge of company dynamics. The team was formed following a logic aimed at maximizing the contribution of know-how,

transferring consolidated experience in relevant sectors into the experimentation and contributing to the achievement of objectives through a structured and methodological approach. The team was configured to ensure an ideal balance between theoretical knowledge and practical skills, creating a flexible and dynamic work environment, where the contribution of each member is valued and oriented towards solving experimental challenges. In selecting the group, particular attention was paid to the ability of individuals to tackle and solve complex problems and to their inclination to manage changing situations, with a rapid decision-making approach based on technical data and specialist knowledge. This has allowed us to build a versatile and resilient team, capable of responding adequately to the specific needs of each phase of the experimentation, maintaining a high level of quality and ensuring constant progress towards the objectives. The company has also favored a team structure that integrates diversified skills, including people with various professional and personal backgrounds, an element that has enriched the experimentation process and has allowed us to tackle problems with multiple approaches, offering different perspectives and helping to strengthen the effectiveness of the proposed solutions. One of the fundamental objectives in defining the team was to promote a culture of collaboration, where the continuous exchange of knowledge represents a strategic added value. Each member is encouraged to express and share their technical contribution and to support colleagues, making the team a context in which learning is constant and adaptive. The company has placed emphasis on the inclusion of individuals with a strong predisposition for continuous updating, thus ensuring that the team is always in line with the most recent technical and scientific developments in the reference sector. In addition, the project was developed in collaboration with other entities, both to broaden the field of available knowledge and to ensure that the technologies and methodologies adopted in the experimentation were fully capable of meeting the standards required in the reference sector.

This synergy with other entities has further strengthened the team's capabilities, allowing it to develop solutions that integrate best practices and that stand out for their effectiveness and sustainability in production processes.

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