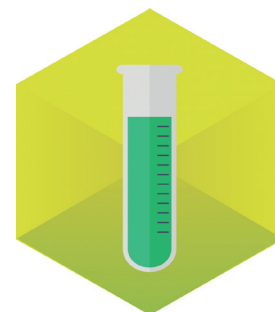


# HYDROTHERMAL OXIDATION

## A CLEAN PROCESS WITH BRIGHT FUTURE

Hydrothermal oxidation (HTO) is an emerging clean technology that provides new solutions for the treatment of various organic wastes. Implemented on an industrial scale in Europe and Asia, this process, which responds to existing environmental challenges, remains poorly known in Canada.



## WHAT IS HYDROTHERMAL OXIDATION?

HTO involves using hot water (150-600°C), under pressure and enriched with oxygen, to generate chemical reactions. The polarity of water decreases as it approaches its critical point at 374 °C and 22 MPa. Water then becomes **a very effective solvent for a variety of organic compounds**.

By enriching so-called *subcritical* or *supercritical* water with oxygen, a highly oxidising medium is obtained, capable of mineralising organic compounds rapidly, exothermically (by releasing energy) and generating water and carbon dioxide.



The hydrothermal oxidation pilot unit of the CTTEI

Under these conditions, **organic compounds are degraded rapidly and with a high energy release**.

The inorganic compounds are recovered as inert, recyclable sand.

## WHY IS HYDROTHERMAL OXIDATION A CLEAN TECHNOLOGY?

The HTO process destroys a range of pollutants using water as the only solvent and the pollutant itself as the only fuel. In addition, it generates recoverable hot water, which can be used, for example, to heat buildings or industrial processes.

## WHAT ARE THE BENEFITS OF HYDROTHERMAL OXIDATION?

The advantages of HTO over conventional processes are numerous.

- **HTO reduces the organic load** of the targeted waste materials.
- **HTO generates heat** from residues with high water content, with a better balance than conventional technologies.
- **HTO does not generate NO<sub>x</sub> or dioxin-furans**, which are harmful compounds for the environment and human health. Its gaseous emissions are therefore less problematic than those generated by combustion.
- HTO treatment is usually quick (about 10 to 20 minutes).
- The HTO process **does not require the use of any solvents or chemicals**.
- HTO can be used to treat highly concentrated effluents (10-100 g/L COD) or effluents containing solids.
- HTO treatment greatly **increases the biodegradability** of organic compounds.

# WHAT IS THE SCOPE OF APPLICATION OF HYDROTHERMAL OXIDATION?

HTO is particularly suitable for residues that are too concentrated or too toxic for biological treatment or discharge to sewer. It is also relevant for high water content residues unsuitable for efficient incineration.

The CTTEI studies hydrothermal oxidation in the following applications:

- Valorization of municipal sludge
- Valorization of paper mill residues with steam generation
- Treatment of concentrated toxic industrial effluents
- Treatment of hospital effluents containing pharmaceutical compounds
- Destruction of microplastics

The following applications could also be developed:

- Recycling of textiles or plastics by depolymerisation
- Hydrolysis of biomass for biorefinery
- Pre-treatment before biomethanisation
- Hydrogen generation by hydrothermal gasification

Coupling HTO with other technologies is of interest, for example, to pre-concentrate an effluent before HTO treatment or to carry out post-polishing treatment. Membrane processes, electrochemical processes and biological processes have already been identified for their potential in this respect.

## HYDROTHERMAL OXIDATION AT CTTEI

### 2014

The CTTEI acquires its first HTO equipment, initiates the first research program on hydrothermal processes in Quebec and begins collaborations with European companies and research centres specialized in the field.

### 2017

The CTTEI obtains the support of the Natural Sciences and Engineering Research Council of Canada (NSERC) for a period of 5 years and begins techno-economic studies on HTO processes.

### SPRING 2020

The CTTEI lays the foundation stone for its new pilot laboratory, the only one of its kind in Canada, thanks to funding from the Canada Foundation for Innovation (CFI).

### 2021

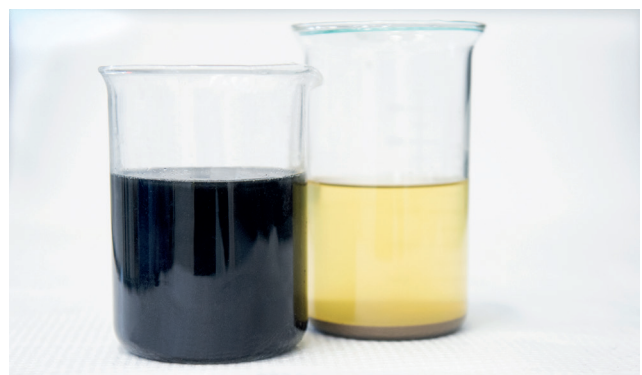
In May 2021, the CTTEI receives the hydrothermal oxidation unit from the manufacturer Inovertis.

On November 16, 2021, the CTTEI inaugurates the first pilot-scale hydrothermal oxidation laboratory in Canada.

## WHAT FUTURE FOR HYDROTHERMAL OXIDATION AT CTTEI?

As part of its technology transfer and applied research activities, the Centre de transfert technologique en écologie industrielle (CTTEI) has demonstrated **the economic and ecological interest** of this technology for the treatment municipal sludges from aerated ponds in the City of Sorel-Tracy – and therefore, many Quebec municipalities.

From laboratory tests to industrial implementation, including technical and economic studies, the CTTEI is pursuing the study of HTO and hopes to develop, with partners, new treatment solutions for various **organic residues**.



Aerated pond sludge, before and after HTO treatment