INRS Institut national de la recherche scientifique

CENTRE EAU TERRE ENVIRONNEMENT

# Decontamination & Valorization

2019-2020

## Each Canadian produces more than 700 kg of solid waste per year; some of this waste has great potential for transformation into valuable materials

Cities and industries face major challenges with respect to waste management, and improved methods are constantly being sought. The INRS Eau Terre Environnement Research Centre is a leader in the development of environmental technologies. Its researchers possess unique expertise in the treatment and valorization (transformation into valuable materials) of effluents, sewage sludge, and contaminated soil and waste. New technologies conceived at the Centre are regularly patented and transferred to industry.

## Examples of research and training applied to current challenges

### Biomass valorization

The production of value-added products such as biofuels and biomaterials from lignocellulosic biomass (forest or crop residues) is an ecological alternative to fossil fuel–based products. This biomass, mainly composed of cellulose, hemicellulose, and lignin, is abundant, renewable, and low-cost. One of the main challenges in valorizing these materials is to develop an effective pretreatment process to remove as much lignin (an essential component of plant cell walls) as possible in order to improve the biochemical conversion of the other components. In this research program, two ecological and economical pretreatment processes, reactive extrusion and biodelignification, will be optimized and combined to improve the cost effectiveness of lignocellulosic biomass valorization.

Photo: Asea! (CC BY-NC-SA 2.0) via flickr

### Pesticide degradation

Atrazine is one of the most used pesticides in North America. It is ubiquitous in the environment and is even found in drinking water. This pesticide is not degraded effectively by conventional water treatments. Two INRS professors have combined their expertise to develop a new process to degrade atrazine without the addition of chemicals. The researchers have optimized the process of photoelectrocatalysis, in which light and electrical potential generate free radicals at the surface of electrodes that interact with atrazine molecules and degrade them. The process has been successfully tested on water samples from a river in an agricultural region of Quebec, but improvements are still underway.

Photo: aqua.mech (CC BY 2.0) via flickr

### $CO_2$ sequestration

The capture, sequestration, and valorization of $CO_2$ could play a vital part in reducing the amount of $CO_2$ released into the atmosphere. The goal is to transform this gas, currently considered a waste product, into a valuable commodity. Combining the valorization of $CO_2$ with that of other waste is the main focus of the INRS industrial carbonation research team. Using mineral carbonation, the group is giving a second life to mine tailings, industrial waste, and other alkaline residues (containing Mg, Ca, and Fe) by fixing $CO_2$ into solid form. The innovative technologies and new materials that the group is developing integrate the principles of sustainable development and circular economy.

## Main study themes and researchers involved



**DECONTAMINATION & VALORIZATION**

**Jean-François Blais** | Decontamination and valorization
jean-francois.blais@ete.inrs.ca
**Patrick Drogui** | Water treatment electrotechnologies
patrick.drogui@ete.inrs.ca
**Louis-César Pasquier** | $CO_2$ sequestration and reuse
louis-cesar.pasquier@ete.inrs.ca


**BIOCONVERSION**

**Kokou Adjallé** | Environmental biotechnologies
kokou.adjalle@ete.inrs.ca
**Rajeshwar Dayal Tyagi*** | Waste bioconversion
rd.tyagi@ete.inrs.ca

** Has left in 2020*

## Examples of recent publications

(Names of ETE Centre's authors are in **bold**)

- Chen J, **Adjalle KD**, Lai TT, Barnabé S, Perrier M & Paris J (2019). Effect of mechanical pretreatment for enzymatic hydrolysis of woody residues, corn stover and alfalfa. *Waste and Biomass Valorization*, ONLINE. https://doi.org/10.1007/s12649-019-00856-x

- **Cuprys A, Lecka J**, Proulx F, Brar SK & **Drogui P** (2019). Appearance of ciprofloxacin/chlortetracycline-resistant bacteria in waters of Quebec City in Canada . *Journal of Infection and Public Health*, 12 (6): 897-899. http://dx.doi.org/10.1016/j.jiph.2019.04.012

- **Du Breuil C, Pasquier L-C**, Dipple GM, **Blais J-F**, Iliuta MC & **Mercier G** (2019). Mineralogical transformations of heated serpentine and their impact on dissolution during aqueous-phase mineral carbonation reaction in flue gas conditions. *Minerals*, 9 (11): Art. 680. http://dx.doi.org/10.3390/min9110680

- **Komtchou S**, Delegan N, **Dirany A, Drogui P**, Robert D & El Khakani MA (2020). Photo-electrocatalytic oxidation of atrazine using sputtured deposited $TiO_2$: WN photoanodes under UV/visible light. *Catalysis Today,* 340: 323-333. http://dx.doi.org/10.1016/j.cattod.2019.04.067

- **Mouedhen I,** Coudert L, **Blais J-F** & **Mercier G** (2019). Prediction of physical separation of metals from soils contaminated with municipal solid waste ashes and metallurgical residues. *Waste Management*, 93: 138-153. http://dx.doi.org/10.1016/j.wasman.2019.05.031

## Examples of research partners

- BOSK Bioproducts
- Consortium de recherche et innovations en bioprocédés industriels au Québec (CRIBIQ)
- Consortium de recherche et d'innovation en transformation métallique (CRITM)
- $ECO_2$
- Government of Canada (Health, Natural Resources)
- Government of Quebec (Environment and Climate Change, Transport)
- Plasma-Quebec
- Québec City