St. Lawrence TECHNOLOGIES

HAZARDOUS WASTES

REGENERATIVE INCINERATOR FOR THE DESTRUCTION OF TOXIC EMISSIONS FROM THE TARPAPER MANUFACTURING INDUSTRY

ABSTRACT

Atmospheric emissions from the manufacture of tarpaper contain, among other things, strong-smelling volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs).

A regenerative incinerator, originally developed to treat light solvent vapours in paint shops, was installed at the Joliette (Québec) plant of the firm Cascades Inc. to determine its destruction efficiency on tarpaper saturator emissions. These tests constituted a first for the North American tarpaper manufacturing industry.

The technology was subjected to a detailed evaluation under operating conditions. Atmospheric discharges comply with the air emission standards in effect in Québec.

MAIN FEATURES

- **Technology**
  - -Regenerative incineration: recovery of heat and energy
  - -Compact installation, simple maintenance and operation.
- **Environment**
  - -Efficient destruction of VOC and PAH emissions
  - -No hazardous wastes generated: filters, sludge, condensates...
- **Cost**
  - -Minimal use of auxiliary fuel
  - -Energy recovery of 85%
  - -Lowest cost of incineration processes for this type of emissions.

ST. LAWRENCE ACTION PLAN

Environment Canada | Environnement Canada
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Cascades INC.

BIOTHERMICA INTERNATIONAL INC.

PROJECT OBJECTIVES

1. To demonstrate the destruction efficiency of the regenerative incinerator on PAH and VOC emissions from a tarpaper saturator.
2. To demonstrate the energy efficiency of this incinerator for this type of industry.
3. To demonstrate the economic viability of this technology.

PHASES

I Literature review: inventory treatment processes and documentation on the nature and toxicity of main chemical compounds to monitor in the atmospheric emissions of tarpaper manufacturing plants.

II Preliminary characterization of emissions at incinerator inlet and outlet: identify organic compounds released by the process; make specific adjustments to sampling methods; select operating conditions for next phase.

III Emission characterization and efficiency performance: analyse VOC and PAH emissions at incineration system inlet and outlet to evaluate compound destruction efficiency; energy and mass balance; study atmospheric dispersion; identify limitations of incineration system; estimate costs of regenerative incineration and compare with other available processes.

BACKGROUND

Tarpaper saturators produce strong-smelling toxic vapours. Conventional treatment techniques for these emissions (gas washing or filtration) have unsatisfactory efficiency rates and produce wastes that are classified as hazardous.

Regenerative incineration had previously only been applied to light solvent emissions prior to its adaptation for the treatment of condensable organic compound emissions. The VOC and PAH destruction efficiency of this system was tested in a demonstration project at the Joliette plant of Cascades Inc. from 1990 to 1992.

TECHNOLOGY

As indicated in the process diagram, saturator emissions are first warmed on contact with the ceramic matrix in bed A, then the organic compounds are oxidized in combustion chamber D. The treated gases are next evacuated through bed C, where they warm the ceramic medium before being released into the atmosphere.

Some of the treated gases are conveyed toward bed B to purge it of residual organic compounds. The flow control valves are periodically activated in a three-stroke cycle to alternate bed functions. A gas-fired burner E supplies auxiliary heat.

The Salem-type incinerator used in the study was modified and adapted by the Canadian firm Biothermica International Inc.

RESULTS

Destruction of organic compounds

Organic compounds in the saturator emissions were 84% to 95% destroyed by oxidation at high temperatures in the regenerative incinerator. Odours and potential carcinogens were almost completely removed. Atmospheric emissions of organic compounds were 1.0 g/L of coatings applied, or 0.3% of the Québec standard of 350 g/L.

Energy conservation

Saturator emissions must be warmed to 830°C in order to completely oxidize organic compounds. Approximately 85% of the energy required (780 kJ of heat per kg of saturator vapours) was recovered in the three-chamber regenerative system. Some 40% of the net heat came from the combustion of organic vapours; the other 60% was supplied by natural gas. The energy needed for cold start-ups corresponds to the energy consumed in 8 hours of normal operation.

Cost of treatment

Capital costs were estimated at $30 per Nm³/h of treatment capacity. Operating costs were assessed at $17/h for 4000 hours of operation. Overall treatment costs are estimated at $7.50 per tonne of tarpaper produced, which is lower than the other incineration processes considered.

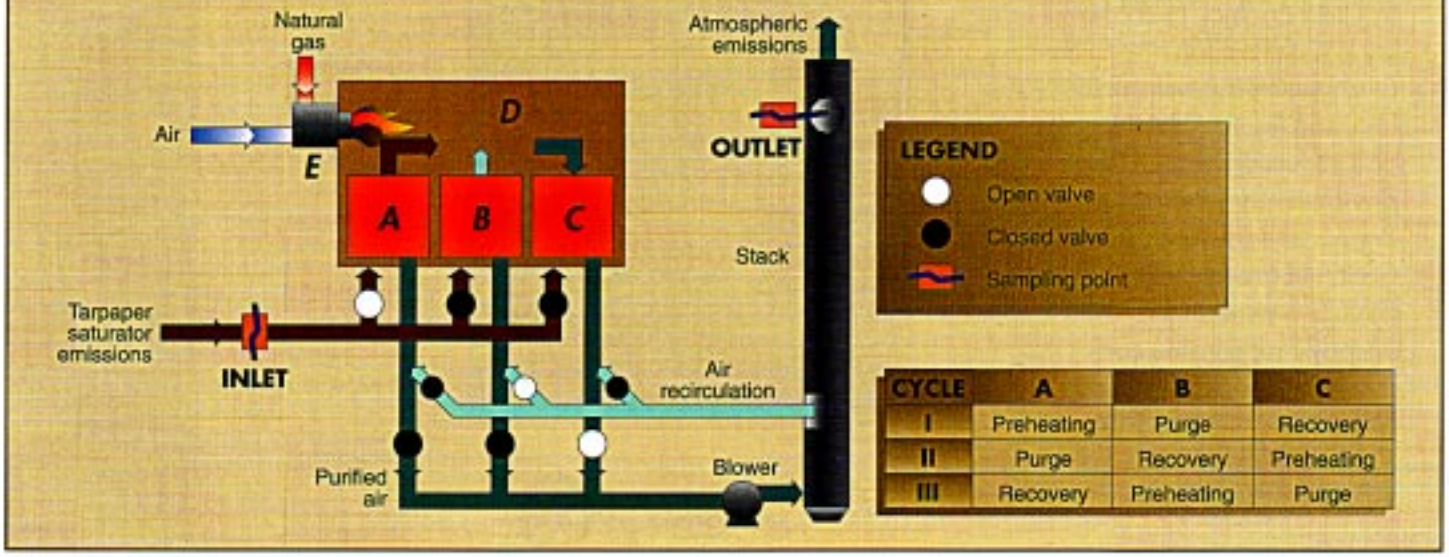
REGENERATIVE INCINERATOR

Destruction efficiency of organic compounds in tarpaper saturator emissions

Organic compounds	Inlet mg/Nm³	Outlet mg/Nm³	Reduction %
Volatile organic compounds (VOCs) (1)	1.48	0.134	91
Polycyclic aromatic hydrocarbons (PAHs) (1)	0.73	0.078	89.3
Aliphatic hydrocarbons (2)	436.0	22.2	94.9
Total organic compounds (TOCs) (2)	1295.9	214.2	83.5

(1) Calculated from test series M-1 to M-3 (standard methods).
(2) Calculated from test series C-1 to C-6 (non-standard methods).
Nm³ = Normal cubic metre.

PROCESS DIAGRAM



POTENTIAL AND LIMITATIONS

Regenerative incineration can treat emissions containing organic vapour loads varying from 0 to 5000 mg per Nm^3. The operation adjusts automatically to variations in emission concentration and flow. For the destruction of organochlorines, combustion temperatures can reach up to 1000°C and more, if required.

Compared to other potentially applicable technologies, regenerative incineration offers a high level of efficiency for the destruction of health-hazardous organic compounds, while avoiding pollution transfer (e.g. toxic filters for disposal, contaminated water), and at a lower cost than other incineration processes.

Due to the presence of a condensable fraction in the saturator emissions, special design features are required to prevent the buildup of tar deposits at the bottom of the beds, as well as overheating at the outlet and fires. The firm Biothermica International Inc. has resolved some of these problems at the Joliette facilities, while other special features still need to be developed.

INFORMATION

This data sheet is based on the results of a technology development and demonstration project carried out by Cascades Inc., in cooperation with the firm Biothermica International Inc., and financed by the St. Lawrence Centre. The Environmental Protection Branch and the River Road Centre of Environment Canada contributed to the scientific supervision conducted by the St. Lawrence Centre.

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St. Lawrence Technologies

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