A New Approach to VOC Abatement

Going beyond compliance.

Fumes-to-Fuel in the Automotive Industry

One of the most important and most expensive components in an automobile, SUV, or truck is the paint. Auto manufacturers create vast amounts of volatile organic compounds (VOCs) in the process of painting cars, which must be abated as required by the Clean Air Act and enforced by the EPA. Many auto manufacturers have experimented with water-based paints to avoid the VOCs in solvent paints but have often experienced poorer finish results and increased costs. The decision to maximize paint finish quality and minimize costs utilizing solvent-based paints has in turn necessitated that VOC abatement be dealt with economically. Since the largest component of VOC abatement costs is the cost of energy, it was apparent that a means to significantly reduce or eliminate this energy consumption had to be found.

The History of Fumes-to-Fuel

The team at Ford Motor Company has demonstrated the technical feasibility of converting VOCs, such as paint fumes, into valuable fuel. The alternative abatement system, also known as "Fumes-to-Fuel," has begun the paradigm shift from thinking of VOCs as emissions that need to be controlled to thinking of VOCs as a valuable source of energy.

In 2001, engineers and scientists from Detroit Edison ("DTE") and Ford Motor Company began working together on a methodology to capture VOC emissions and convert them to a fuel source to create useful electricity, rather than simply be destroyed in a process that consumes considerable quantities of natural gas. The joint venture between Ford and DTE Energy culminated in the Fumes-to-Fuel technology ("FTF") which was successfully piloted in 2003 at the Ford Rouge Plant in Dearborn, Michigan.

The pilot system in the Ford Rouge Plant captures paint fumes and concentrates them in a piece of equipment that is the core of this process, a fluidized bed concentrator. The highly concentrated VOCs are then fed into a fuel cell reformer, which liberates hydrogen gas to power fuel cells. Based upon the positive results within the Ford Rouge Plant, the next step in the optimization of the process was to replace the high cost fuel cell with a more competitive means of converting the chemical energy to electricity, and Stirling engines were selected for this task. Stirling engines can cleanly burn a wide variety of fuels, including concentrated VOCs, to yield shaft power, which can drive a conventional electrical generator. Ford has installed a full scale FTF system utilizing an STM Stirling engine in their Michigan Truck plant, located in Wayne, Michigan. This full scale system has been operating since the end of September 2005.

Ford and Edison now have applied for substantial US and international patents protecting the concept of Fumes-to-Fuel. Climate Technologies Corp., a Michigan Corporation, participated with Ford and DTE in the conceptual design, development, and acquisition of the hardware required to conduct both demonstration projects. In recognition of their substantial contribution, Climate Technologies was awarded the worldwide licensing rights to market the patent-pending FTF technology.

Fumes-to-Fuel System Economics

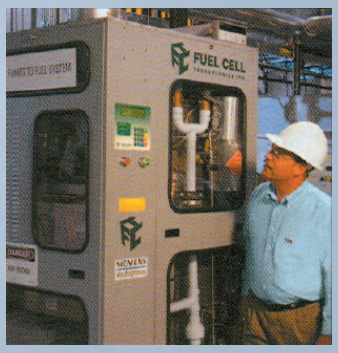
Ford has estimated that the FTF ten-year life-cycle cost is one-fourth the cost of a traditional VOC abatement system, based upon natural gas at $10 per million BTUs. They anticipate that these savings will grow as the cost of natural gas rises. The elimination of such a significant component of the cost to manufacture a vehicle creates a clear competitive advantage.

achievements

Fumes-to-Fuel

The paint shop at the renovated Ford Rouge Center in Dearborn, Michigan, not only is helping to generate great current-model vehicles, it's helping to generate great current.

For years, Ford, like other automakers, has incinerated the fumes drawn from paint booths in order to help protect air quality. But now, in Fumes-to-Fuel, a pilot program jointly developed by Ford Motor Company and Detroit Edison, usable electric energy is being generated by what was formerly a worthless waste product. The system captures the volatile organic compounds found in paint fumes and concentrates them into a rich mixture of hydrocarbons that are then converted to a hydrogen-rich gas. The gas is fed into a stack of solid oxide fuel cells, where a chemical reaction between hydrogen and oxygen molecules is used to create electricity. The only emissions from the fuel cells are water vapor and an insignificant amount of carbon dioxde.



Fumes-to-Fuel fuel cell

Patent pending in the United States and internationally, the system is capable of generating about 5,000 watts of electricity — enough to power an average home. Ford and Detroit Edison are exploring larger fuel cells and additional energy generators with a larger system planned for later in 2004.

Excerpted from Ford's 2003 Annual Report

	Units	Regenerative Thermal Oxidizer (RTO)	Traditional Concentrator plus RTO	Electrical Power Generation
Thermal Demand	Million BTU/hr	7.5	2.0	0.08
Electrical Demand	kW	188 kW demand	41 kW demand	36 kW credit
NOx Emissions	tons/year	4.7	1.3	0.2
CO_2 Emissions	tons/year	4250	1480	430
VOC Emissions	tons/year	8.1	6.8	4

Based on 50,000 cubic feet per minute of exhaust with 100 parts per million VOCs for 8230 hours per year.

The FTF system earned Ford the US Environmental Protection Agency Clean Air Excellence Award in 2003

Forbes.com • 2/14/05

Paint Power

Excerpted

Rival manufacturers are taking notice, too: "Toyota and General Motors are now benchmarking the Rouge, which is exactly what Bill Ford wanted," says Timothy J. O'Brien, vice president of corporate relations, who heads up Ford's environmental strategies. Honda Motor (nyse: HMC – news – people) has also inquired about the technology.