APPLIED CATALYSTS

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**<u>Case Study</u>: Use of Oxidation Catalyst in Bakery**
Industry: Food
Application; Commercial Bakery

## Application and Problem

A customer requested Applied Catalysts provide a catalyst for use in a commercial bakery application. The customer indicated the catalyst needed to meet new more stringent emission standards than those previously required for the application. The * Destruction and Removal Efficiency or (DRE), had to meet new State EPA regulations of 95% or greater ethanol destruction efficiency. Also, the standard had to be maintained under variable operating conditions.

Ethyl alcohol or ethanol is produced in relatively small quantities during the fermentation process in the baking of bread and bread related products. During this process concentrations of ethanol produced are approximately 5 lbs. per ton of bread. In the presence of fermentation yeasts and heat, carbohydrates, or sugars found in the dough are converted to ethanol and carbon dioxide.

$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$

At temperatures found in the baking process the ethanol is vaporized and can be easily transferred to the catalytic oxidizer using specialized air handling equipment.

## Action

After review of temperatures, flow rates and conversion requirements of the application; one catalyst was selected to be the optimum choice for the application. The product selected was a highly active precious metal coating deposited on a ceramic monolith. The airflow rate from the baking ovens to the catalytic oxidizer was approximately 3000 SCFM. The inlet temperature was 500 - 550 $^{o}$F. For safety reasons, the engineering company made sure the ethanol concentration was well below 25% of the Lower Explosion Limit, (LEL) as it entered the catalytic oxidizer. The catalyst monoliths were then installed in the oxidizer system and pressure checks were made to test for leaks.

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Once completed, a break-in procedure was begun to test all the associated equipment and sensors.

The specially designed catalyst utilized a thermally stable ceramic monolith as a support structure. The cell density of the monolith was 230 cells per square inch or (CPSI). This cell density provides a relatively high geometric surface area (GSA). While maximizing surface area for catalyst deposition, this cell density also provides an acceptable pressure drop, which is beneficial in reducing overall energy costs related to the operation of the catalytic oxidizer.

## Results

Under all conditions found in the commercial bakery operation, the catalyst met and exceeded all performance targets including (1) ** Catalyst activation or light-off temperature of the catalyst, (2) Destruction efficiency of 95% or higher; typical conversions were greater than 98% and (3) Mechanical and thermal stability of the ceramic monolith and catalytic coating.  The catalyst continues to yield a 98% or greater conversion efficiency after  10,000 hours of operation.

## Definitions

*  Destruction and Removal Efficiency (DRE):  The % efficiency of an oxidation system in causing the destruction and removal of particular targeted organic compound(s). Conversion of these compounds result in the formation of  (1) Carbon dioxide (2) Water and (3) Heat. In terms of destruction efficiency, the value is calculated by determining the mass emission rate of the selected hydrocarbon(s) and dividing this number by the mass input rate of the same hydrocarbon(s).

** Catalyst activation temperature (light-off temperature): Temperature at which the catalyst begins to burn (destroy) the target organic compound(s).

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