Technical Challenges for flex fuel application and TWC optimization for PV segment

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Outline

- ✓ **Flex fuel role in meeting climate and air quality goal**
- ✓ **Emissions challenges poised due to Ethanol blend in gasoline vehicles**
- ✓ **TWC development to meet the emission challenges**

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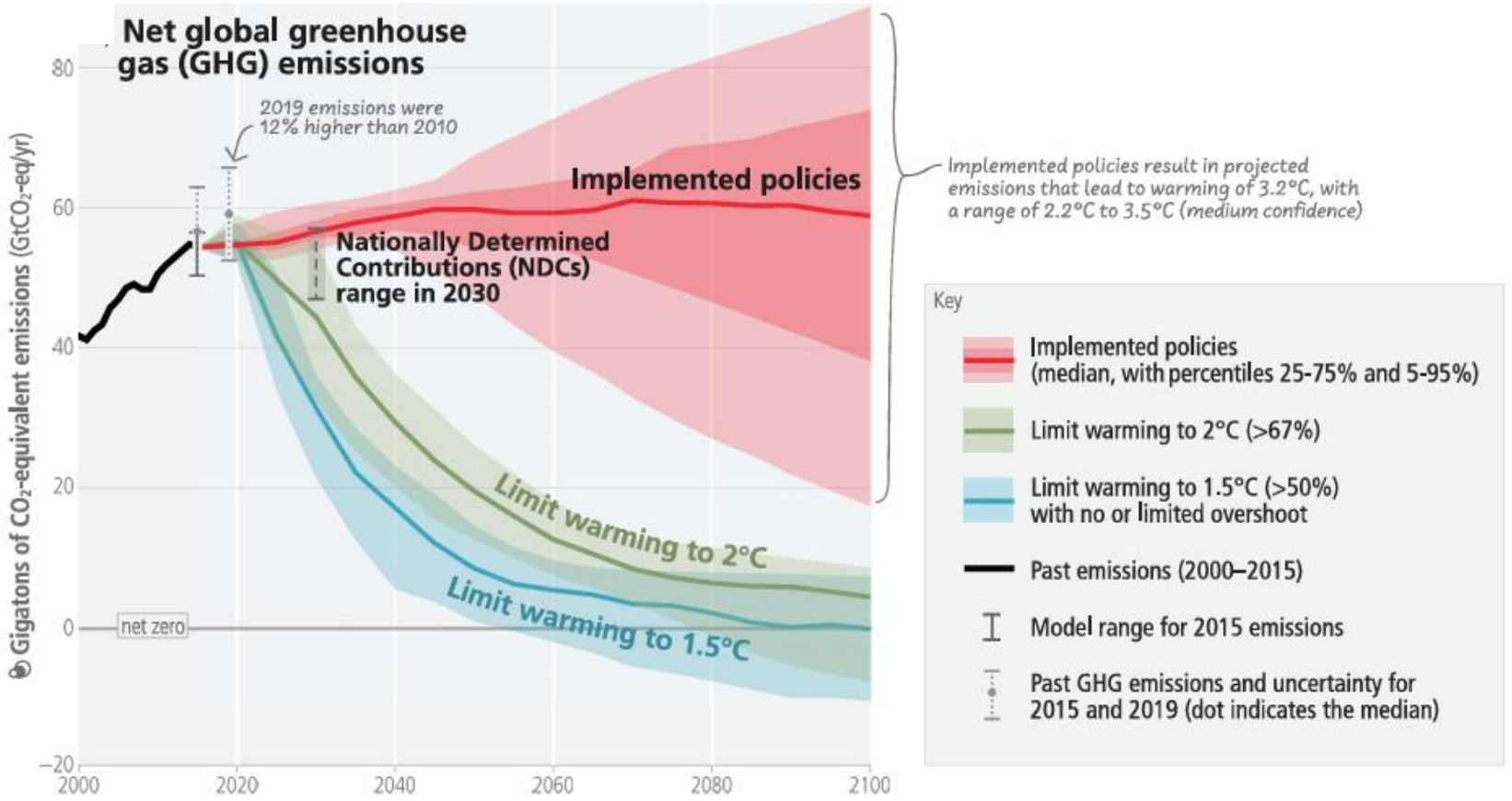
1.5°C target: CO_2 emissions would have to be cut by 45% by 2030



Each additional degree of warming significantly increases the frequency and severity of extreme weather events, ecosystem damage, and risks to human health

Reference: International panel on climate change synthesis report -2023

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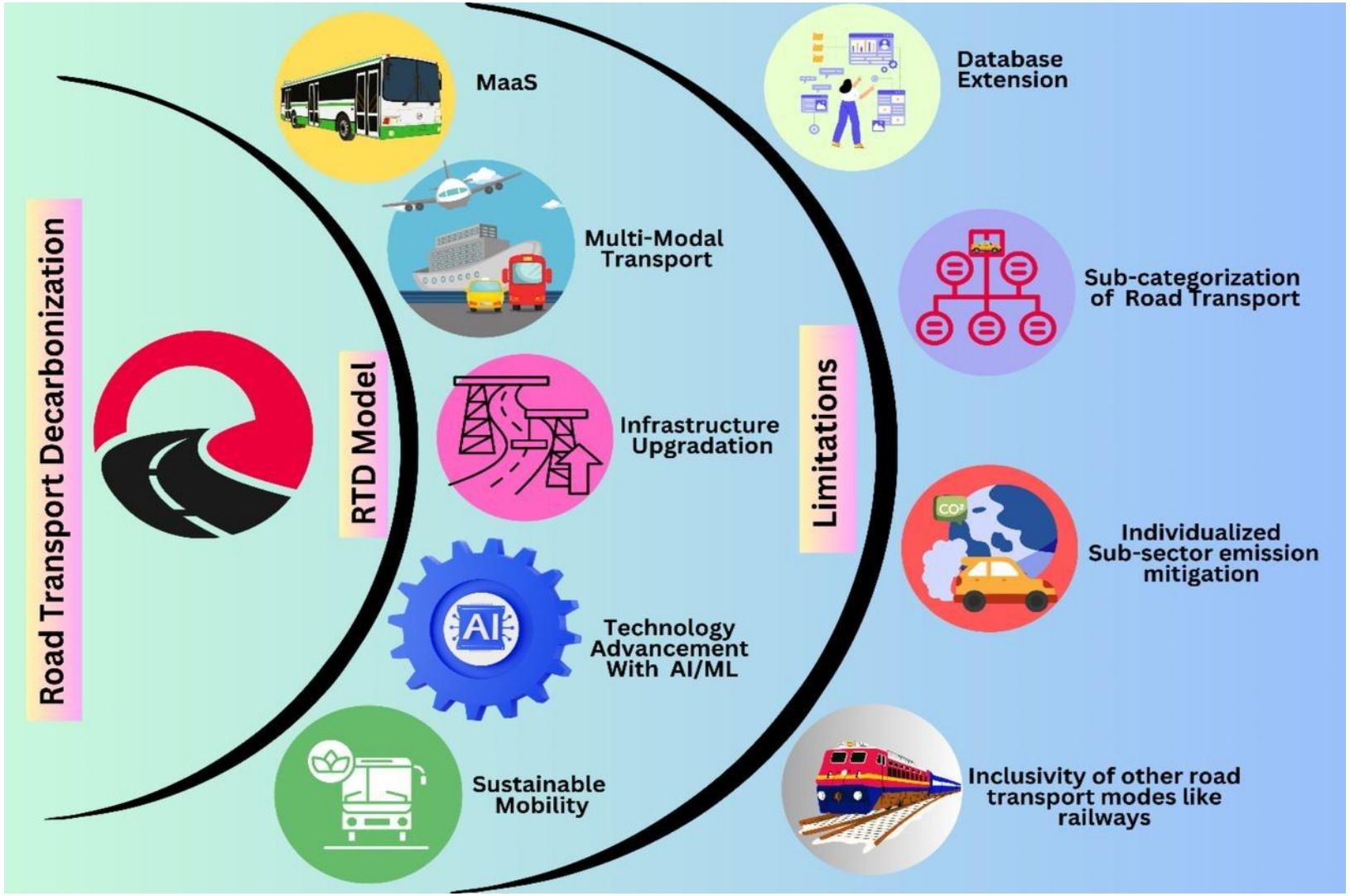
Multi-modal transport solutions accelerate net-zero road emissions.



Circular economy principle, use of biofuels enhance emission reduction

JM Reference: Decarbonizing road transport: A systematic literature review based on use case analysis

Ethanol Blending

- ✓ **Improve Energy Security**
- ✓ **Reduce Air Pollution and Greenhouse Gas Emissions**
- ✓ **Utilize Surplus Agricultural Production**
- ✓ **Increase Fuel Quality**

Changes in fuel blend composition directly impact fuel properties and engine-out emission performance.

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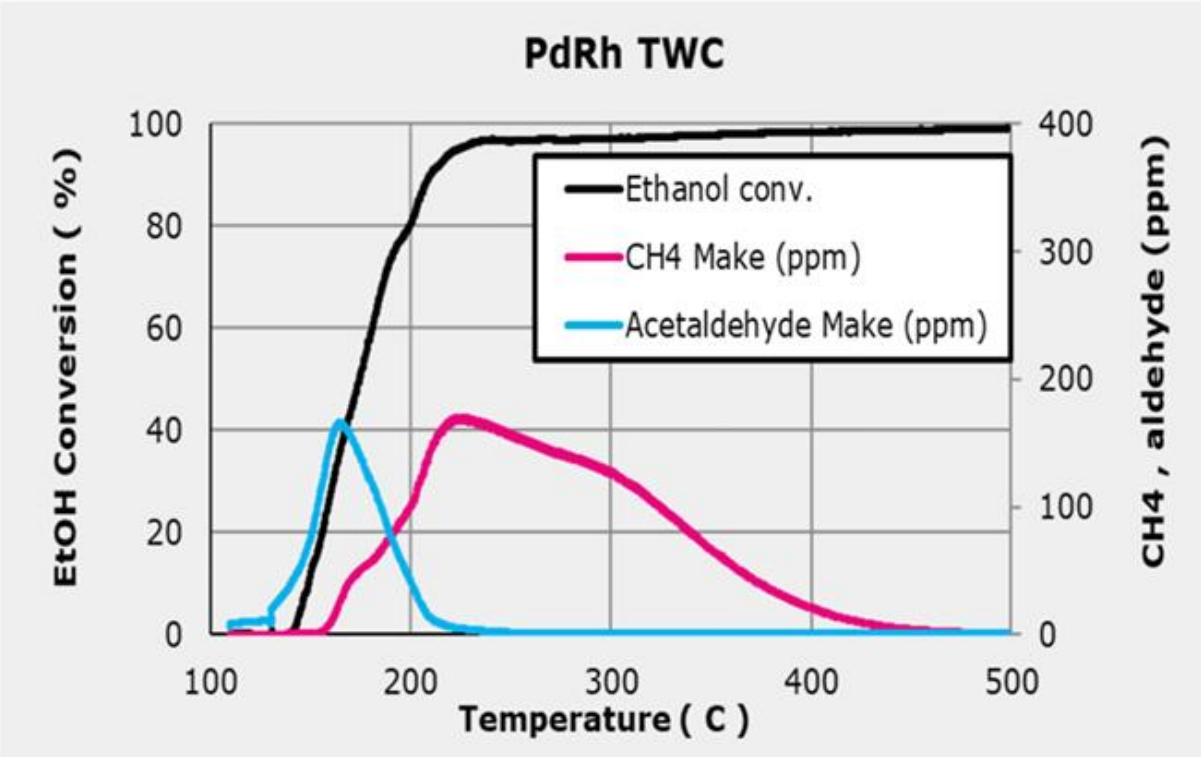
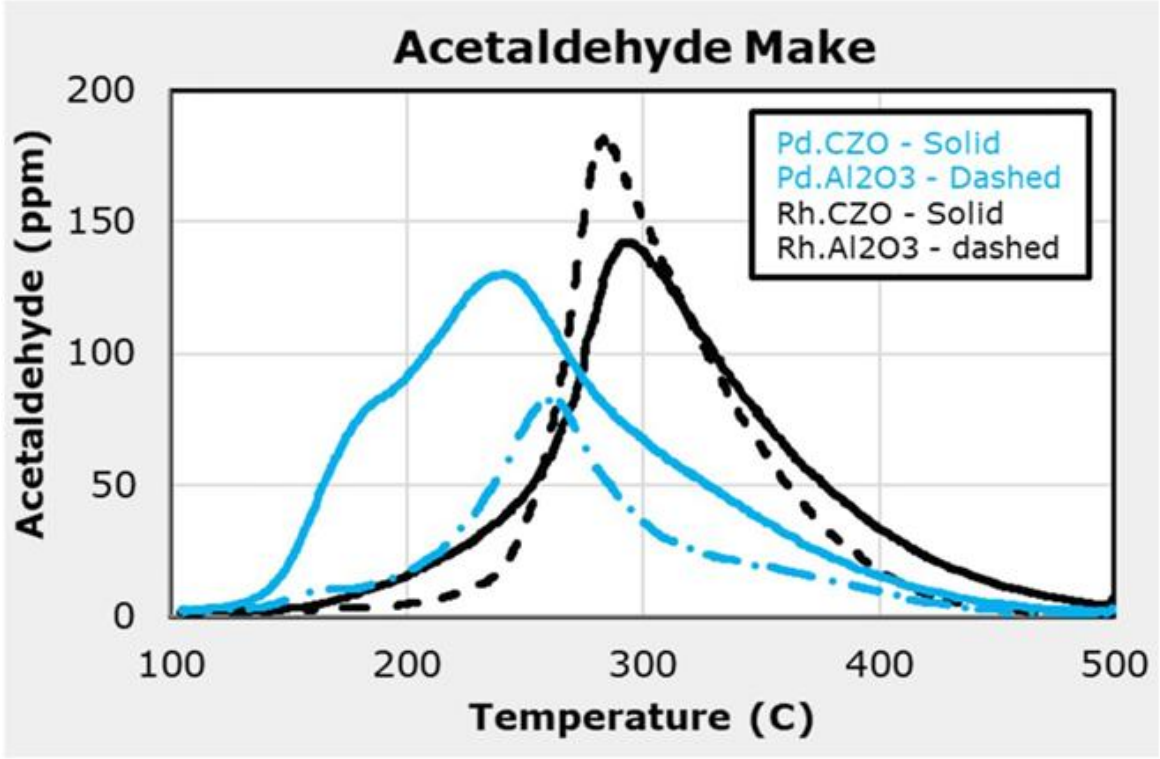
Sequential ethanol oxidation/decomposition behavior | Approach of TWC design



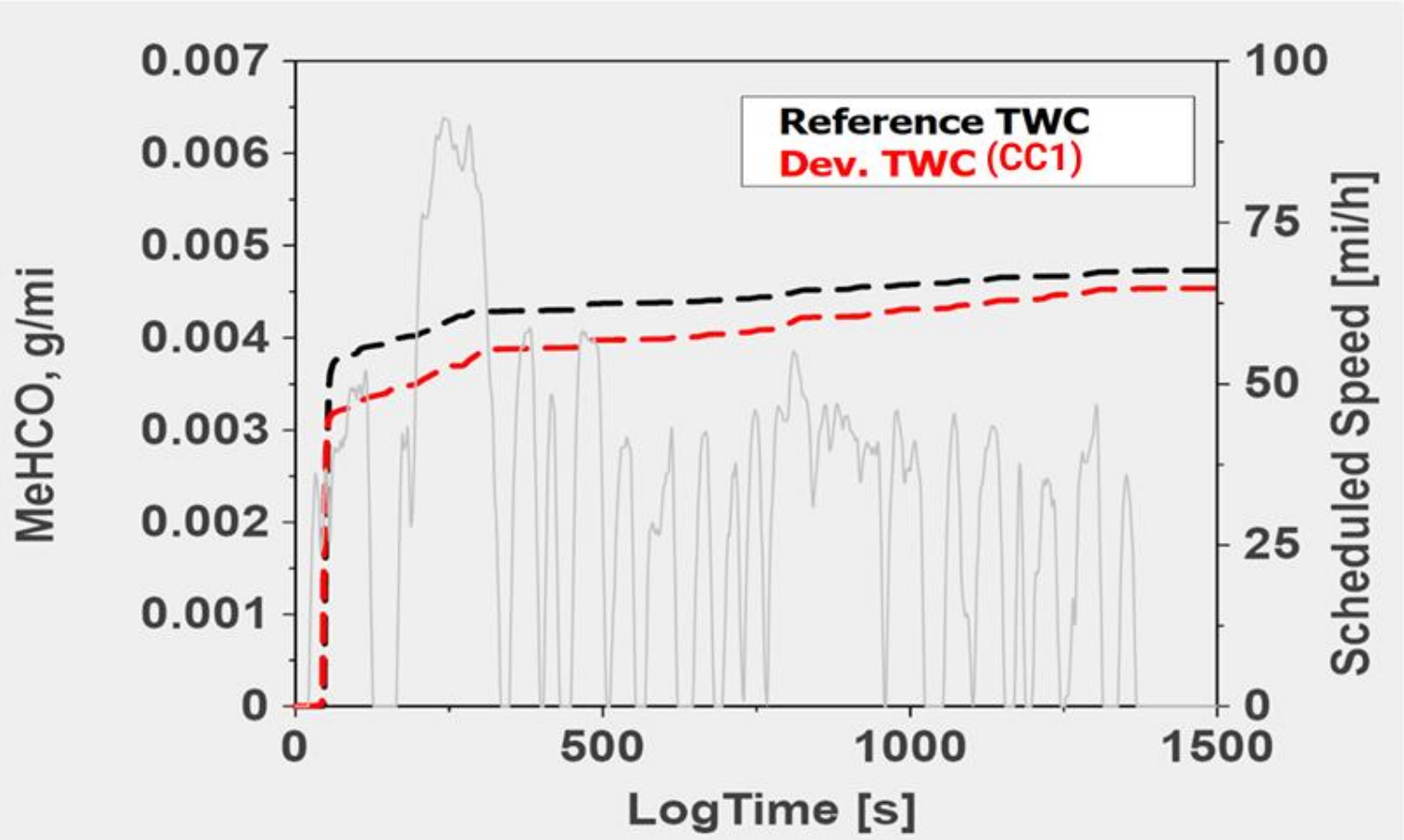
Acetaldehyde and Methane generation on a conventional PdRh TWC catalyst.

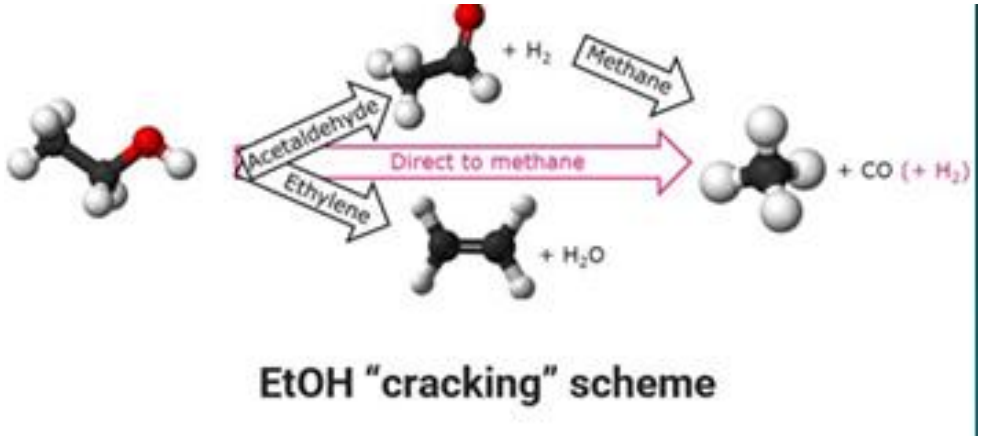


Acetaldehyde generation over a variety of TWC components.

The data included herein were collected in a Johnson Matthey laboratory which has not been certified by the relevant authorities/agencies to perform emissions testing. These are indicative data and do not represent a guarantee that the tested catalyst or emissions system will pass the relevant emissions legislation.

Dev TWC shows lower acetaldehyde emission than Ref.





EtOH "cracking" scheme

Reduction in acetaldehyde formation by alternating reaction path-way

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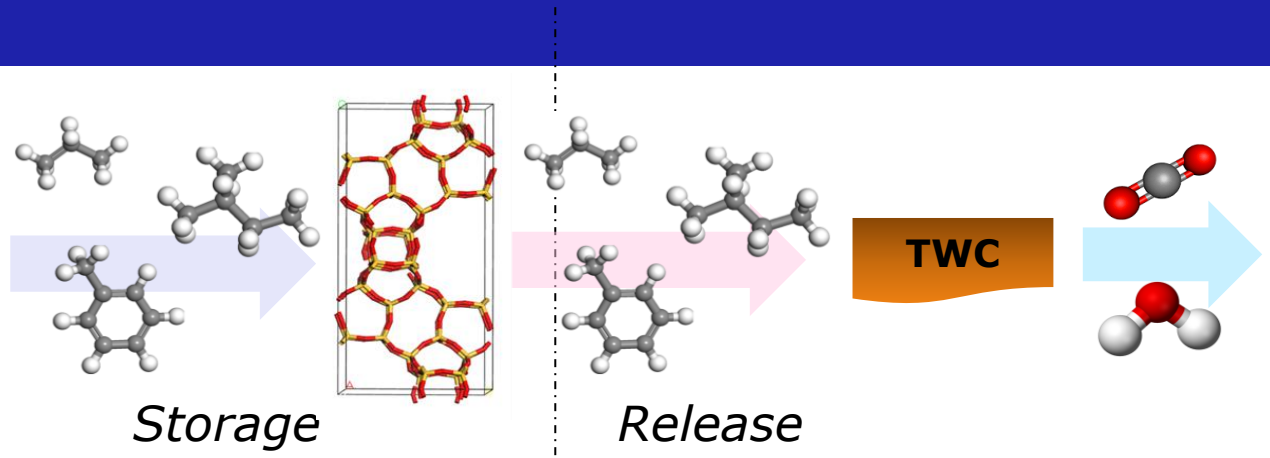
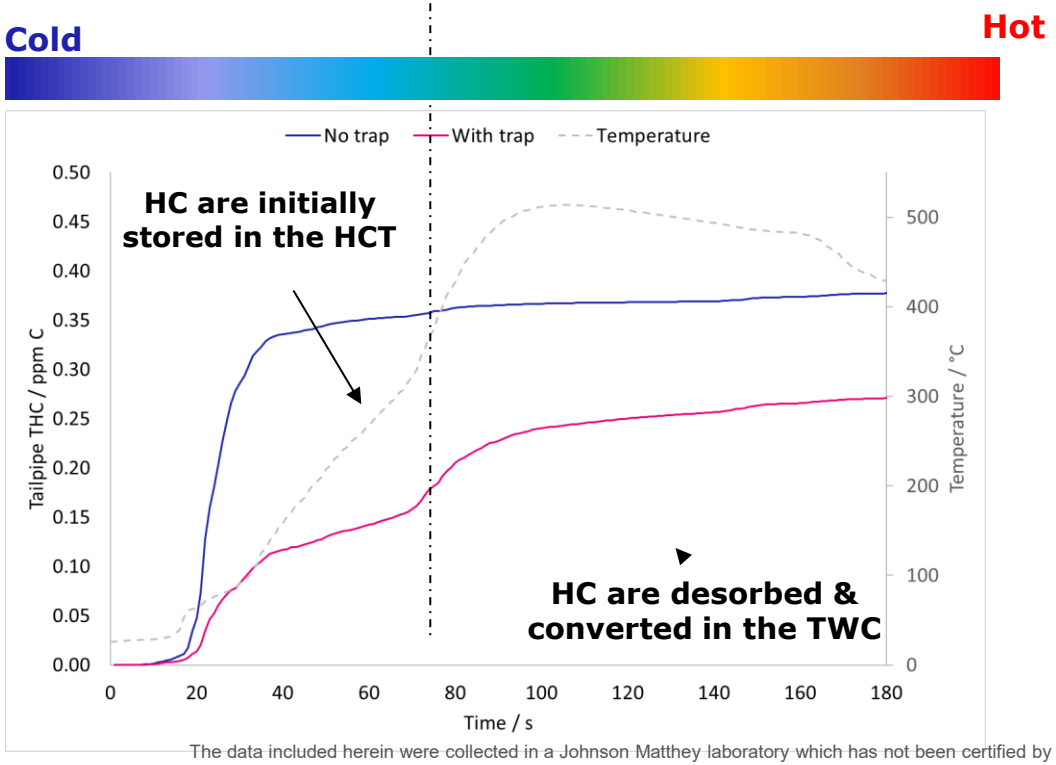
Development Approach | HC adsorption function addition





HC Trap technology: to adsorb HC at cold start stage and oxidize it when temperature warm up

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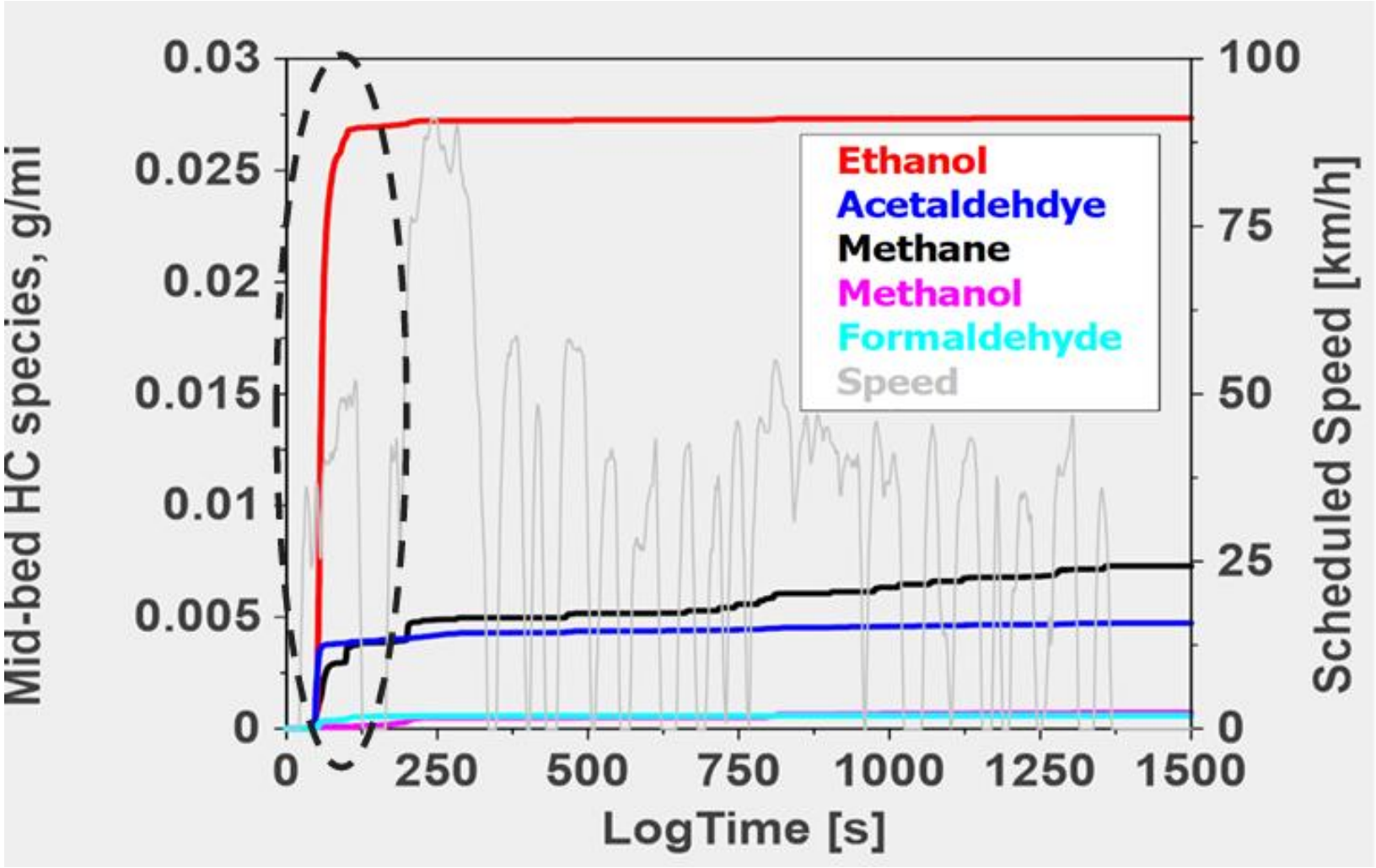

Ethanol is the major HC species, accompanied by acetaldehyde and methane

Half of the acetaldehyde and methane from the cold start, the other half cumulated throughout the rest of the cycle

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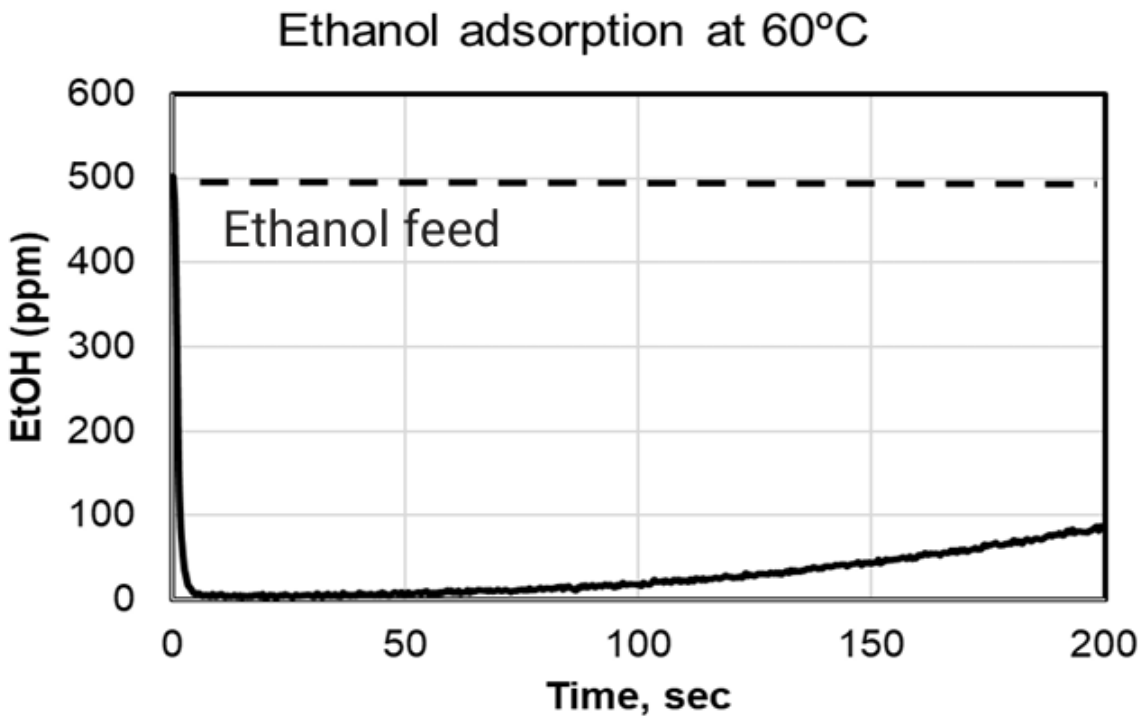
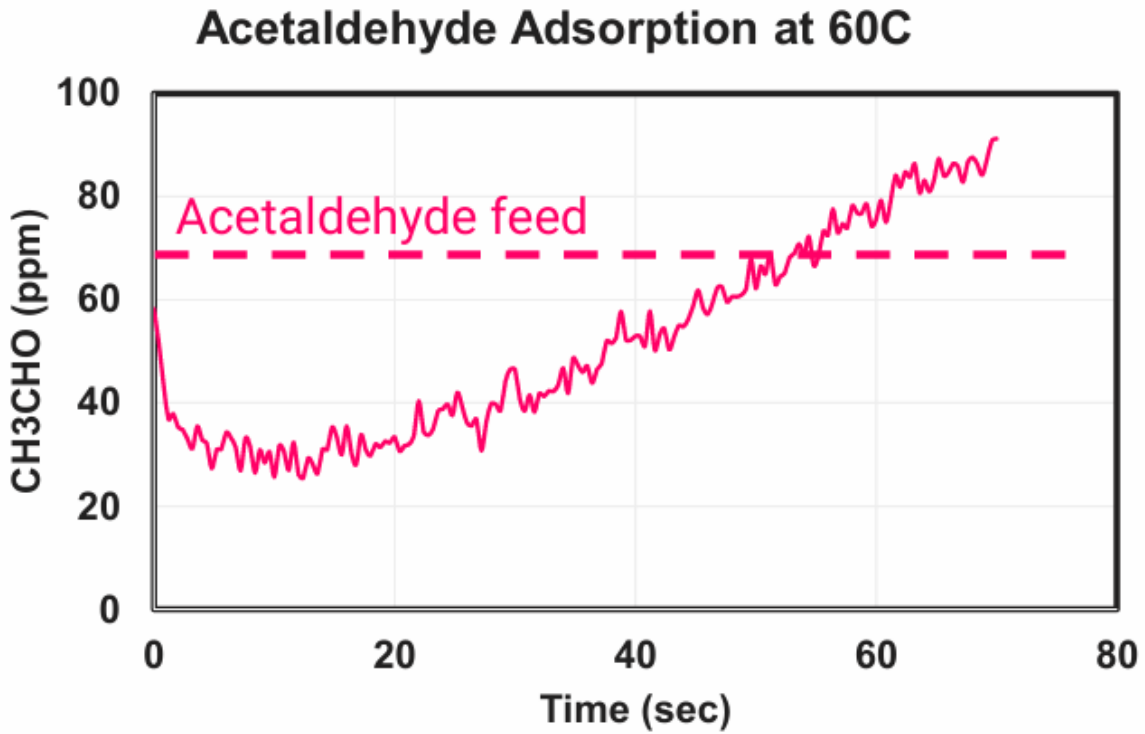
Zeolite-Metal shows very high EtOH adsorption capability but moderate capability for acetaldehyde adsorption





500 ppm EtOH, 70 ppm acetaldehyde, in presences of gases H_2O, NO , CO_2 and N_2

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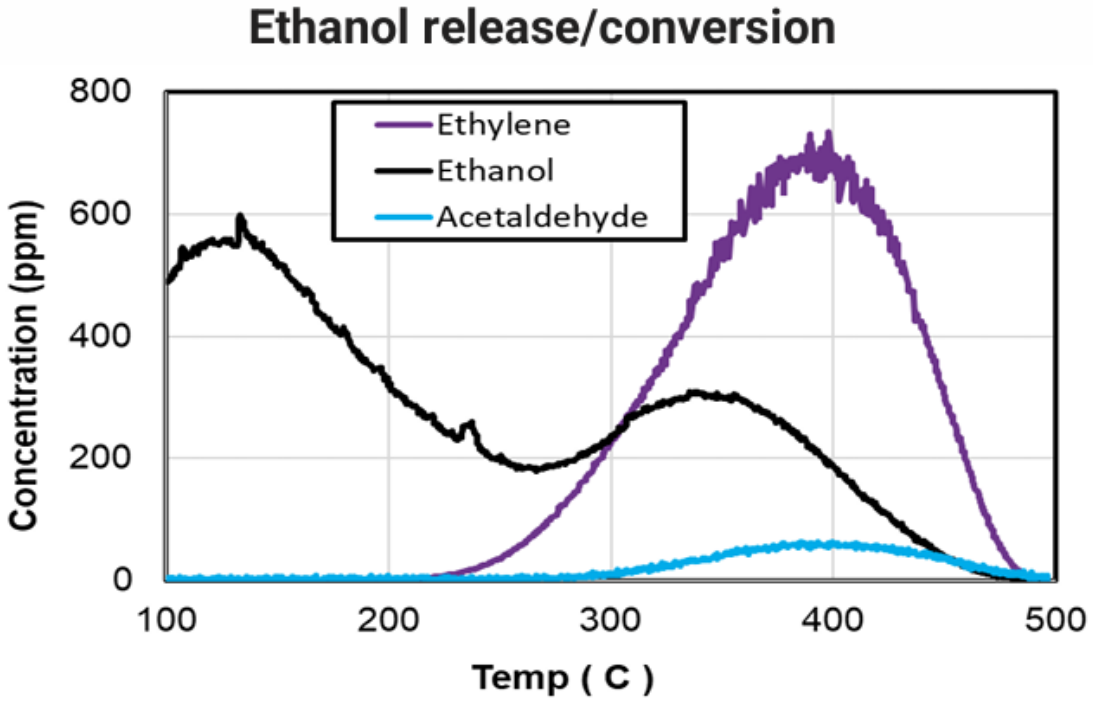
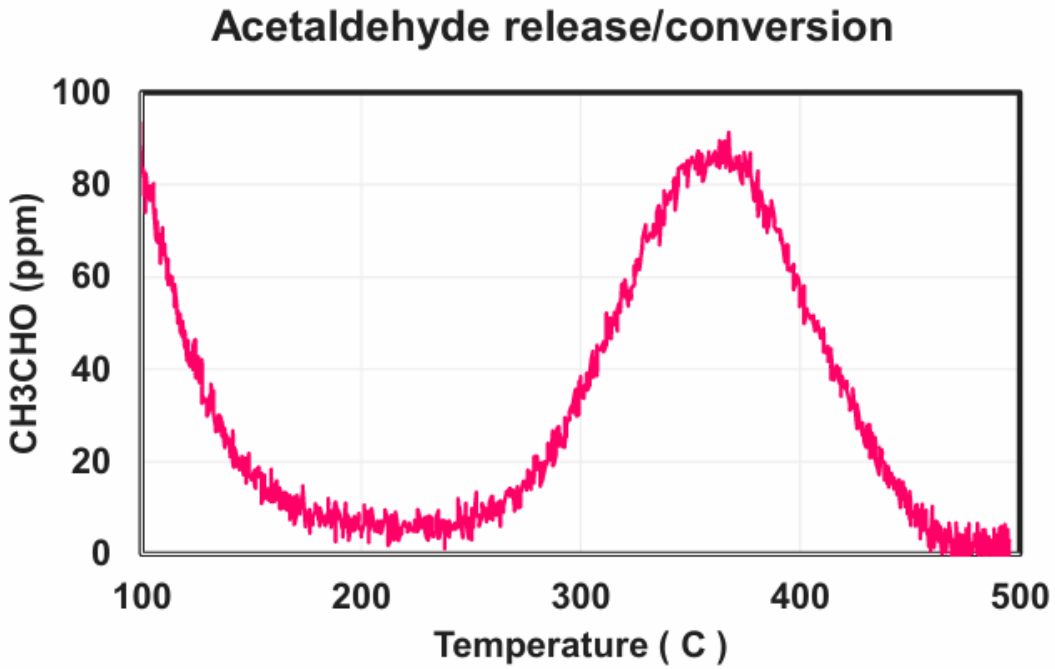
Zeolite-Metal has no HC conversion function | HC trap catalyst needs a TWC component





500 ppm EtOH, 70 ppm acetaldehyde, in presences of gases H_2O, NO , CO_2 and N_2
Ramp up from 60°C- 500°C over zeolite+metal

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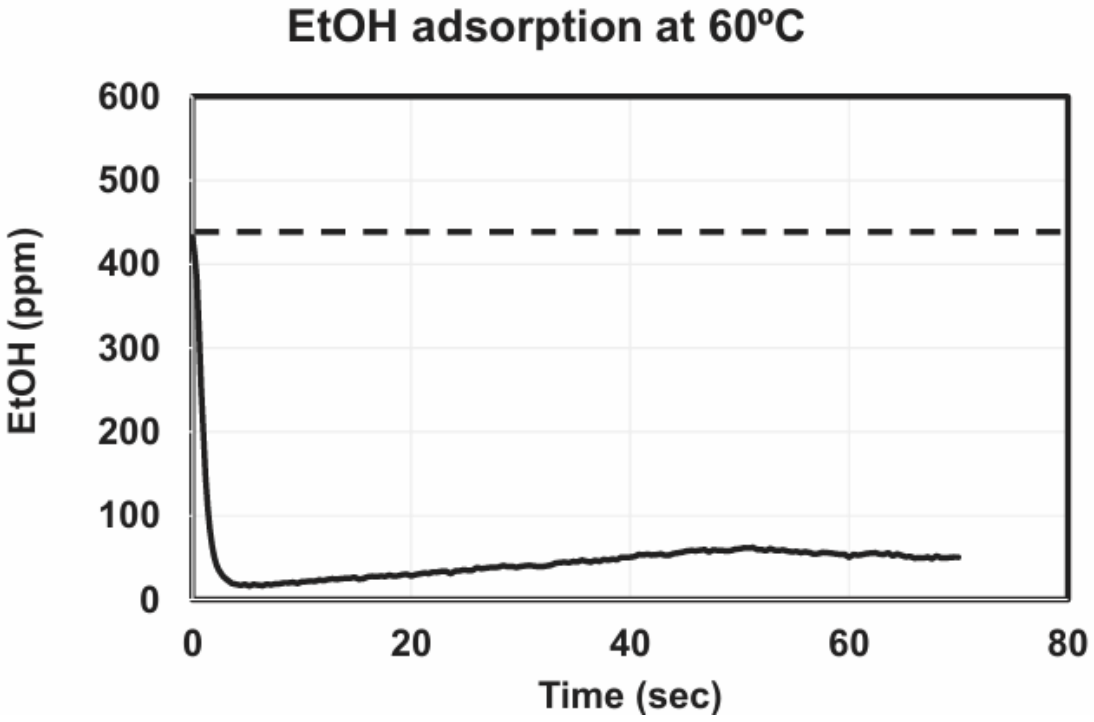
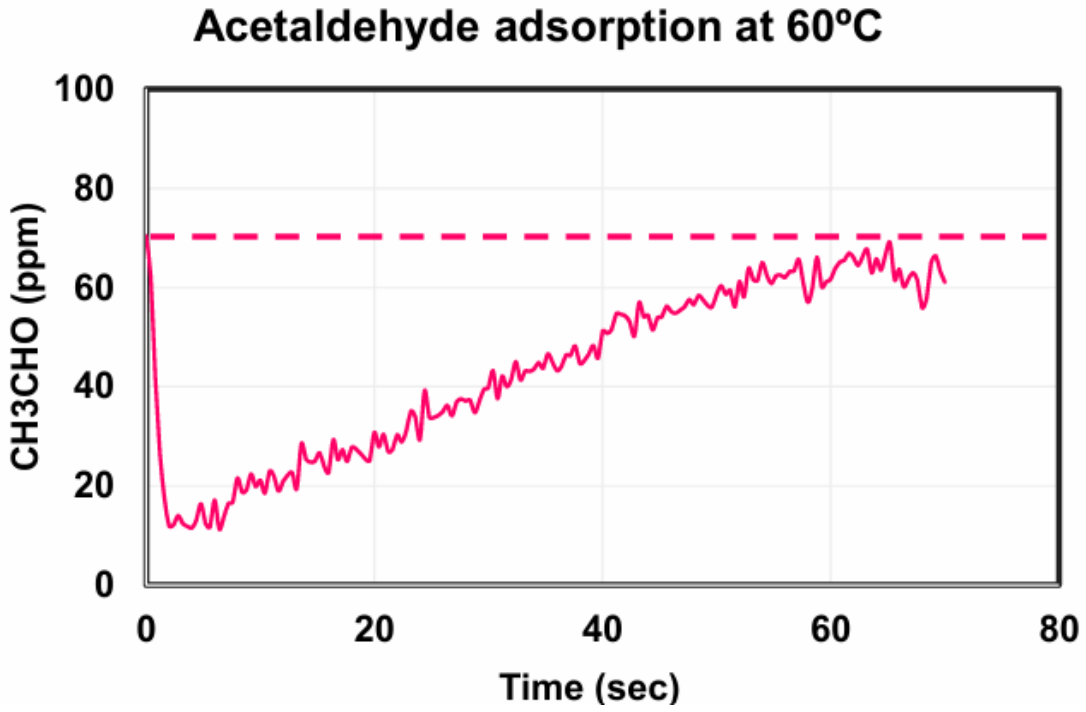
Fully formulated HC trap catalyst shows improved adsorption capability





430ppm EtOH, 70ppm acetaldehyde, 500 ppm EtOH, 70 ppm acetaldehyde, in presences of gases H_2O, NO , CO_2 and N_2, T= 60ºC for 70 second over fully formulated HC trap catalyst

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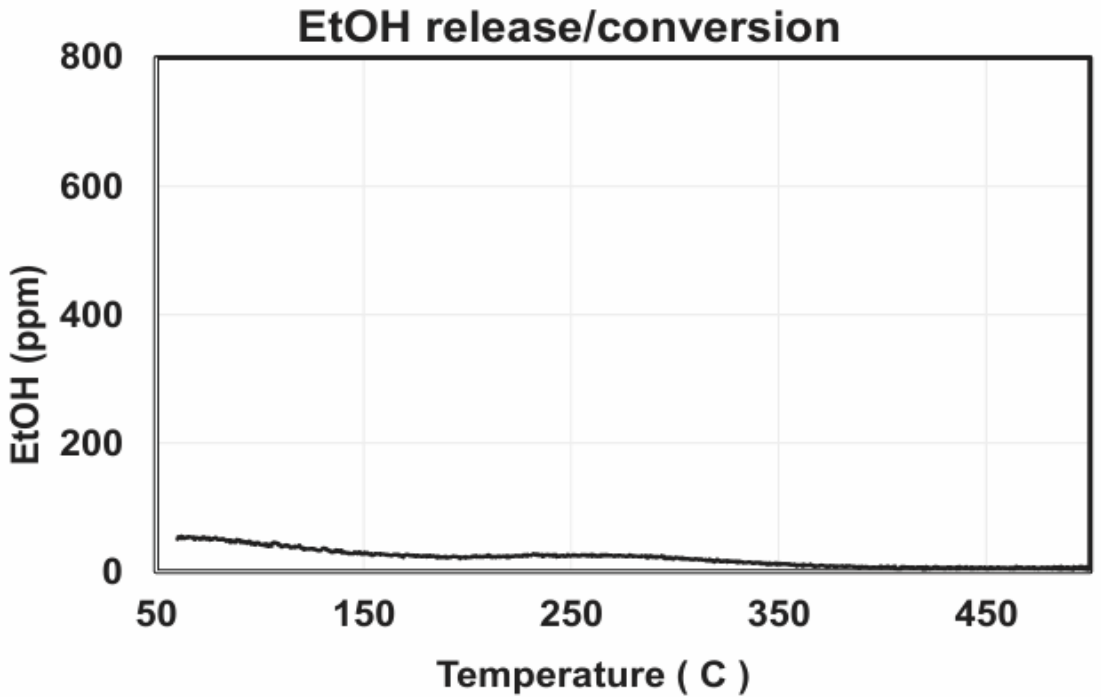
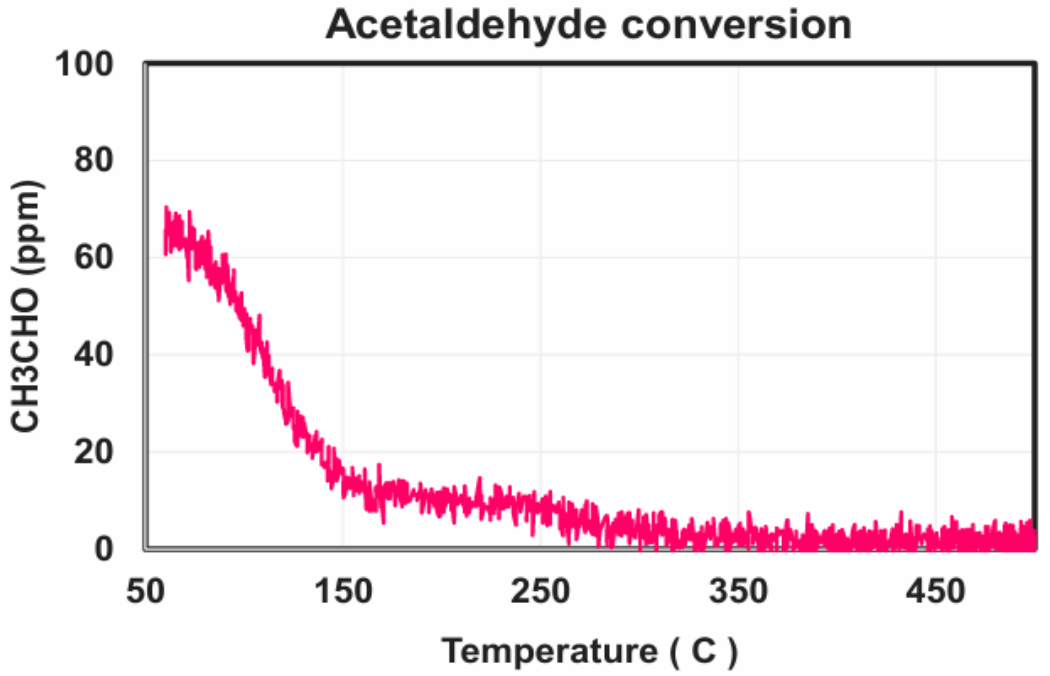
Fully formulated HC trap catalyst shows remarkable HC conversion function





430ppm EtOH, 70ppm acetaldehyde, 500 ppm EtOH, 70 ppm acetaldehyde, in presences of gases H_2O, NO , CO_2 and N_2, T= 60ºC for 70 second over fully formulated HC trap catalyst

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Summary

- ✓ Aldehydes emissions are real challenge, especially for E85/100 scenario
- ✓ Advanced TWCs can reduce acetaldehyde formation by changing reaction route
- ✓ HC trap catalyst shows great EtOH adsorption capability but moderate capability for acetaldehyde
- ✓ Remarkable HC conversion function obtained over a fully formulated HC trap catalyst with a TWC layer

JM Johnson Matthey