Instrument: Large Scale Collaborative Project
Thematic Priority: FP7-ENERGY.2009.3.3.1
Grant Agreement: 241718

TECHNOLOGY OFFER:
ACETALS BY DIRECT OXIDATION OF ALCOHOLS

OVERVIEW

Description: Process ☑, Pilot ☐, Product ☐, R&D knowledge ☑, Other ☐

Benefit summary: Single step oxidation of alcohols to acetals.

Development summary: Reaction has been studied in the laboratory. Commercial catalysts have been selected and can be used for this reaction.

IP Summary: The technology is supported by 20 Granted Patents, including 3 JP Patents, 2 CN patents and 1 US Patent.

Novelty

- **Technology Benefit description:** Catalytic processes, including catalysts selection for direct synthesis of methylal (DiMethoxyMethane, DMM) and DEE (DiEthoxyEthane).
- **Technology differentiation versus competition (and Uniqueness):** State of the art technologies require first an oxidation to aldehyde and then a further acetalization in separate reactors. The inventions describe catalysts and processes to make the direct oxidation of alcohols to acetals.

Development

- **Technology Readiness Level (Scale):** TRL 1 ☐; 2 ☐; 3 ☐; 4 ☑; 5 ☐; 6 ☐; 7 ☐; 8 ☐; 9 ☐
- **Development Status summary:** the reactions have been tested at laboratory scale. Several commercial catalysts can be used for this reaction. Iron-Molybdate catalysts used industrially for methanol oxidation to formaldehyde, at low partial pressure of methanol, surprisingly gave high DMM yield when tested at high methanol partial pressure. Similarly a catalyst formulation well known for acrolein oxidation to acrylic acid was tested in the low methanol concentration conditions and gave the best ever reported DMM productivity in these conditions. Existing catalyst recipe can be used to prepare the catalysts for the direct oxidation to acetals.

Intellectual Property

Patent Application / Granted

Priority Patent Number	Title	Countries	Status	Priority date
PCT/IB 05/053098	Process for preparing partial oxidation products of Lower alcohols by direct oxidation	AT, BE, CN, DE, DK, ES, FR, GB, IT, JP, NL, PL, RO, SE, US	Granted	20/09/2005
FR08.53667	Oxidation of Alcohols to Acetals	CN, FR, JP*	Granted	03/06/2008
FR08.54966	Synthesis of Acetals at high alcohol partial pressure	FR, JP*	Granted	22/07/2008

* Patents have been filed in other countries.

Know-how on applications of acetals is also available from Arkema. Dimethoxymethane is used for the synthesis of PolyOxyMethyleneDiMethoxyMethane (POMM). These POMM can be used as fuels, including for fuel cells. They can also be used as formaldehyde substitutes in embalming formulations.

Instrument: Large Scale Collaborative Project
Thematic Priority: FP7-ENERGY.2009.3.3.1

Grant Agreement: 241718

Provider

- **Technology provided by:** ARKEMA FRANCE
- **Related Expertise:** Catalyst selection and Process Design.

Partner	Academic/Industry	Research / Pilot / Demonstration / Other
ARKEMA	INDUSTRY	Arkema is a producer of fatty nitriles/amines through its subsidiary CECA
Other Owners of know-how on Related Technology		
CNRS	Academic	Within EuroBioRef Arkema and CNRS-UCCS have collaborated to improve the Process. CNRS-UCCS has some experience of the selective oxidation reactions.

Technical Details

- **Long description:** The technology offer includes a Patent portfolio of 3 patent families, and 20 granted patents. 2 different catalyst families have been identified working in different process conditions, leading to selective production of DiMethoxyMethane by direct oxidation of Methanol. DMM is a well know solvent, but can also be used as a fuel. Direct oxidation of ethanol leads to DiEthoxyEthane, although the yield achieved so far is lower than in the case of methanol.

Licensing

- **Collaboration type sought:** Licensing, Transfer of IP. Arkema is no longer a formaldehyde producer since it diverted this activity. All the IP related to this topic can be transferred.
- **Support provided:** Documentation. Arkema was a Formaldehyde producer in the past (by methanol oxidation over Iron-Molybdate catalysts and Silver catalysts), but no longer operates such plants nor pilot units.

CONTACT DETAILS:

Name: Jean-Luc DUBOIS

Address: Arkema France, DRD – Corporate R&D, 420 Rue d'Estienne d'Orves, 92705 Colombes, France

E-mail: jean-luc.dubois@arkema.com

Phone number: +33 4 72 39 85 11

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement Nº 241718.