

*kuraray*

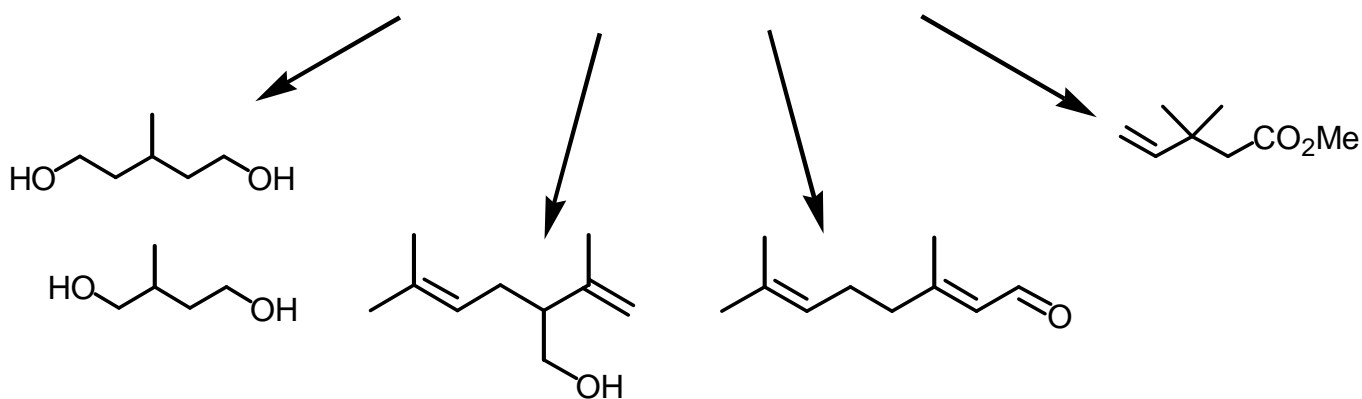
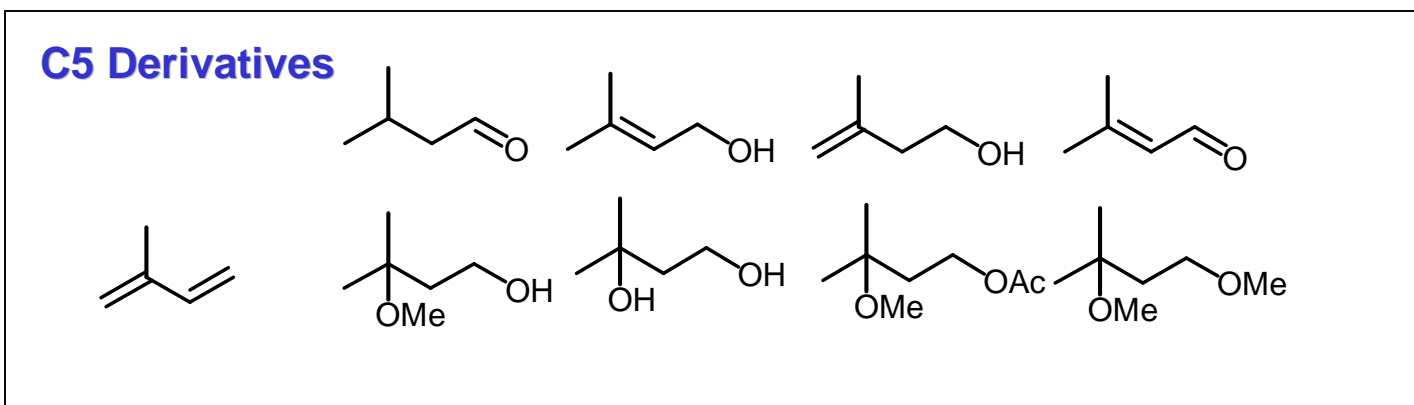
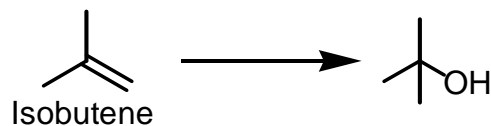
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# **Kuraray's Chemicals**

**Kuraray Co., Ltd.**

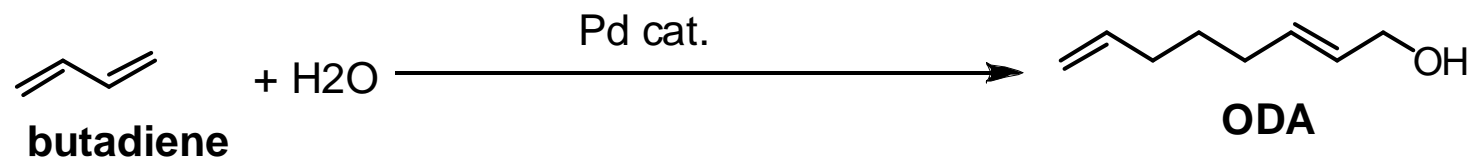
- 1. Unique C5 derivatives**
- 2. Unique C8 derivatives**
- 3. Transition Metal Catalyzed Reaction**
- 4. Selective Hydrogenation and Reduction**
- 5. Diels-Alder Reaction**
- 6. Other Reactions & Products**
- 7. Process Design & Development**

# 1. Unique C5 Derivatives

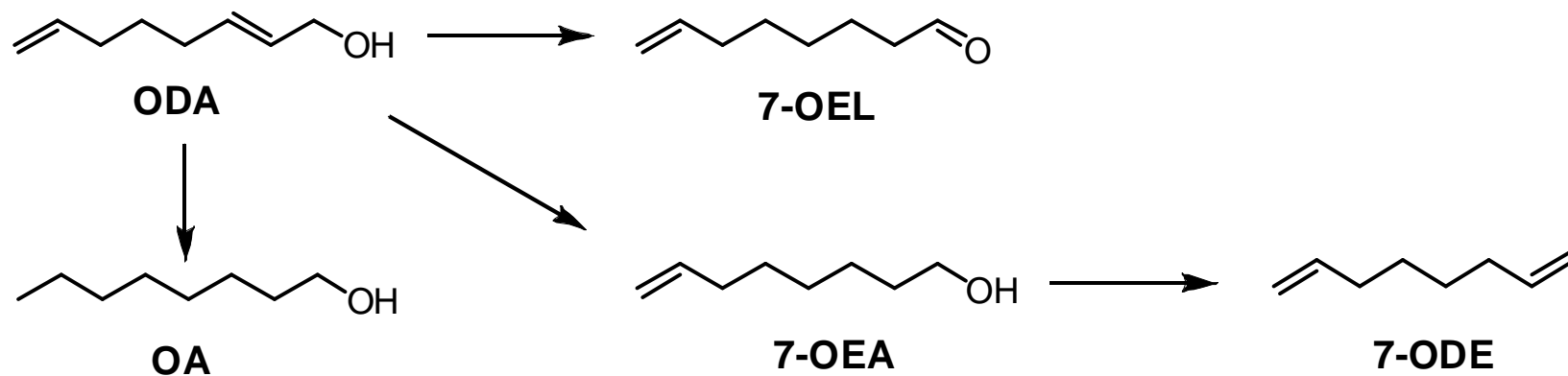


**Applications : Solvent, Cleaner, Resin, Aroma & Agro Chemicals**

### Pd-catalyzed Selective Dimerization & Hydrolysis

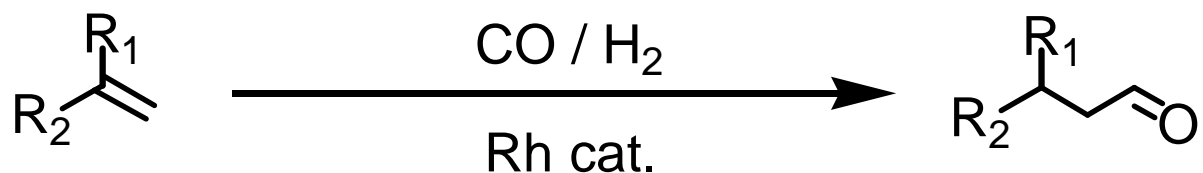


### C8 Derivatives from ODA



## Hydroformylation

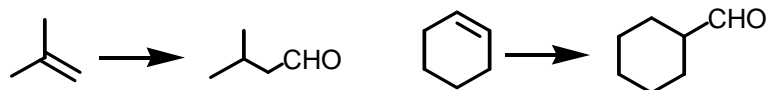
### Special system of Rh/Ligand catalyst



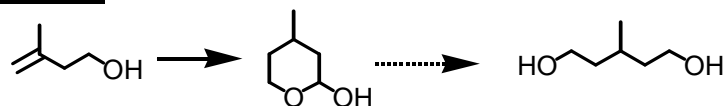
- Manufacturing of a wide variety  
of products from small quantity to large quantity.
- Usable for various functionalized olefins  
examples :  
aromatics, alcohols, ethers, aldehydes, esters, etc.

## Specific Examples of Hydroformylation

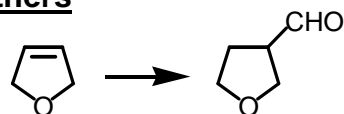
### Hydrocarbons



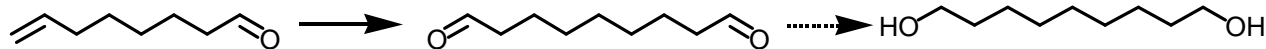
### Alcohols



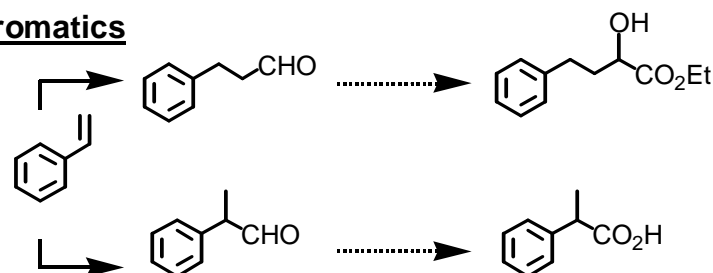
### Ethers



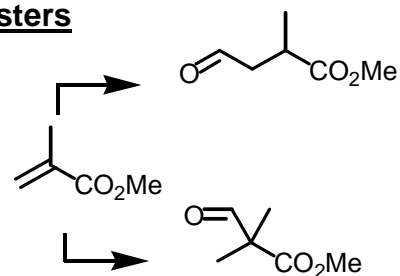
### Aldehydes



### Aromatics



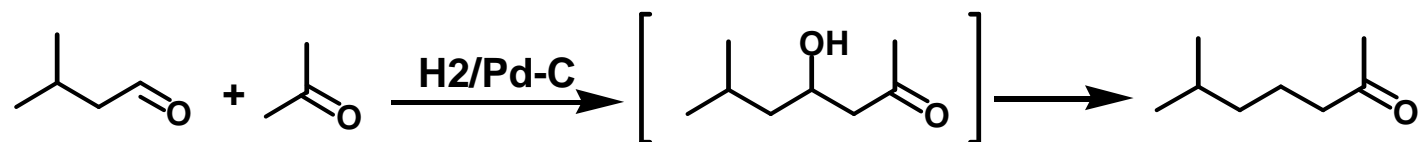
### Esters



## Selective Hydrogenation

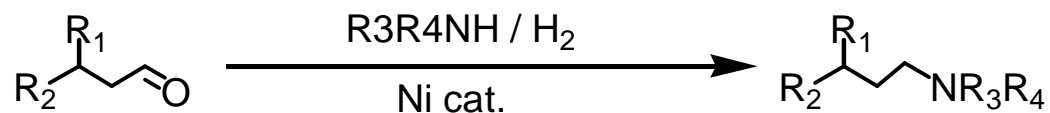


## One-pot Synthesis using Selective Hydrogenation

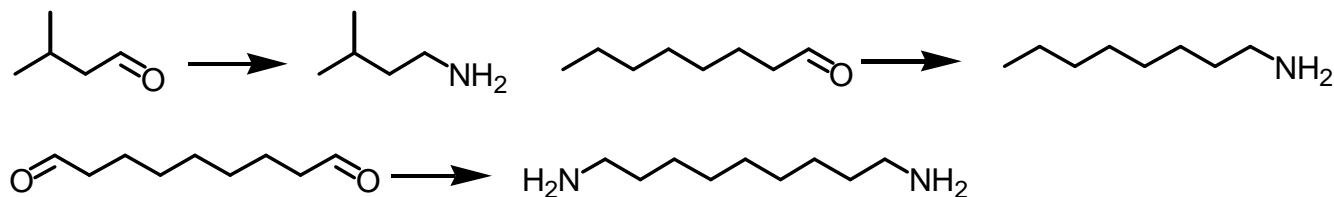


Condensation, dehydration, Hydrogenation

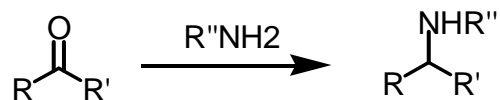
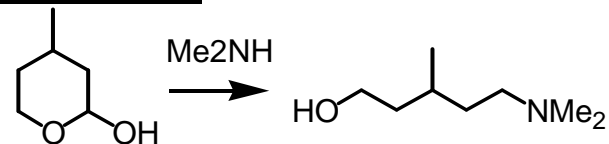
## Reductive Amination



## Specific Examples

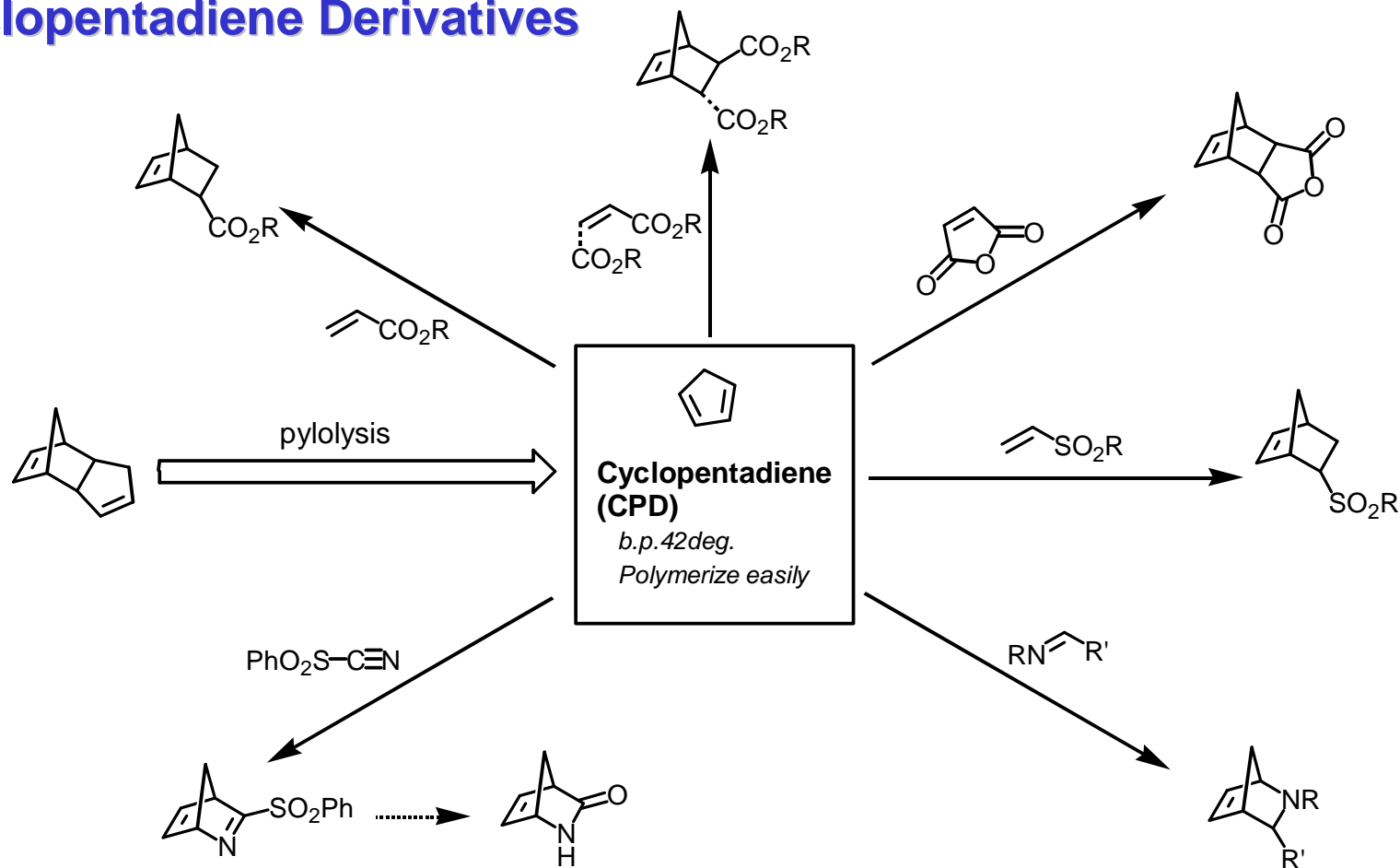
Primary Amine

*Combination Hydroformylation with Reductive Amination*

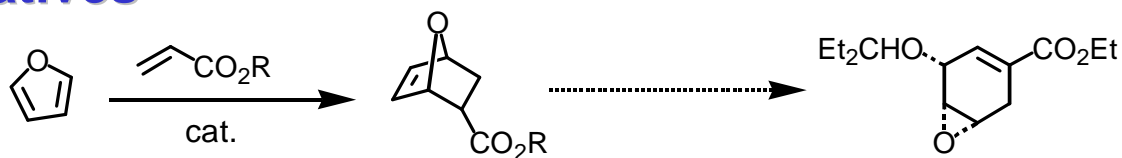
Secondary AmineTertiary Amine

# 5. Diels-Alder reaction

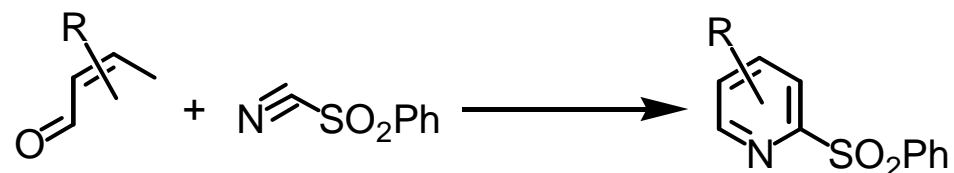
## Cyclopentadiene Derivatives



## Furan Derivatives

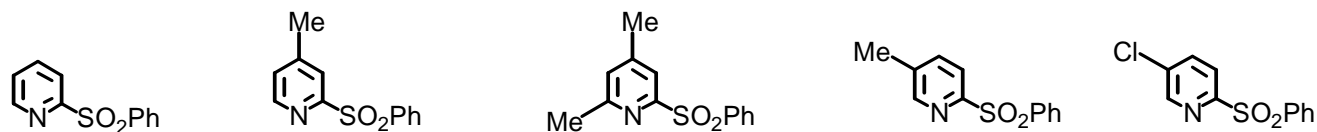


### Hetero Diels-Alder Reaction



- High Regioselectivity (No Regio Isomer)
- PhSO<sub>2</sub>-Groups are Convertible to Various Functional Groups  
ex. O-,N-,S-,C-nucleophiles

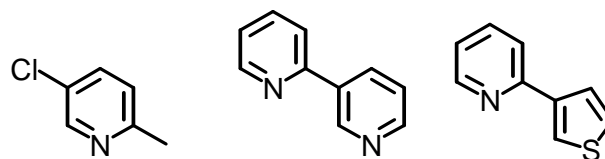
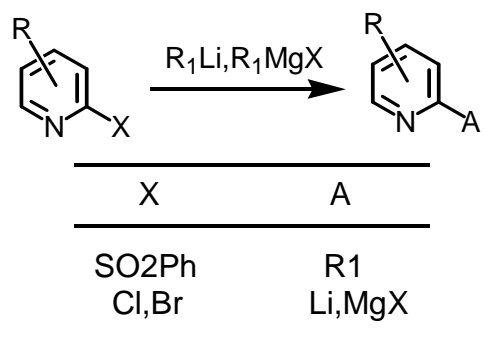
### Specific Examples of Sulfonyl Pyridines



## Unique Reactivity of Sulfonyl Pyridines

Compared with Halopyridines ,  
Sulfonyl Pyridines have unique reactivities.

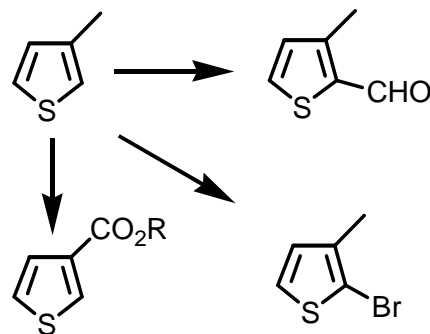
### Direct Substitution



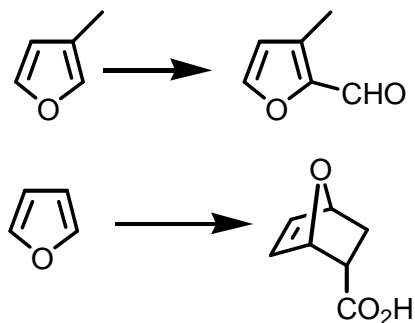


**Heterocycles**

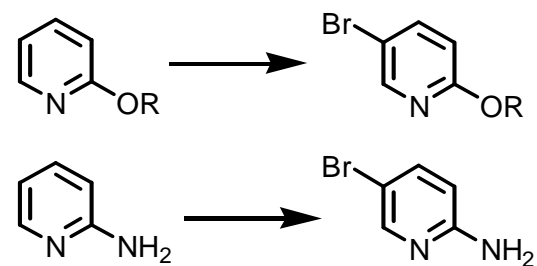
**Thiophenes**



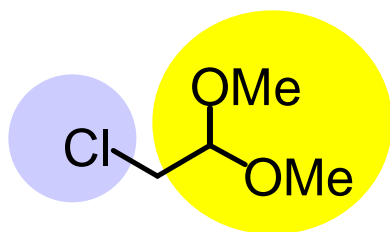
**Furans**



**Pyridines**

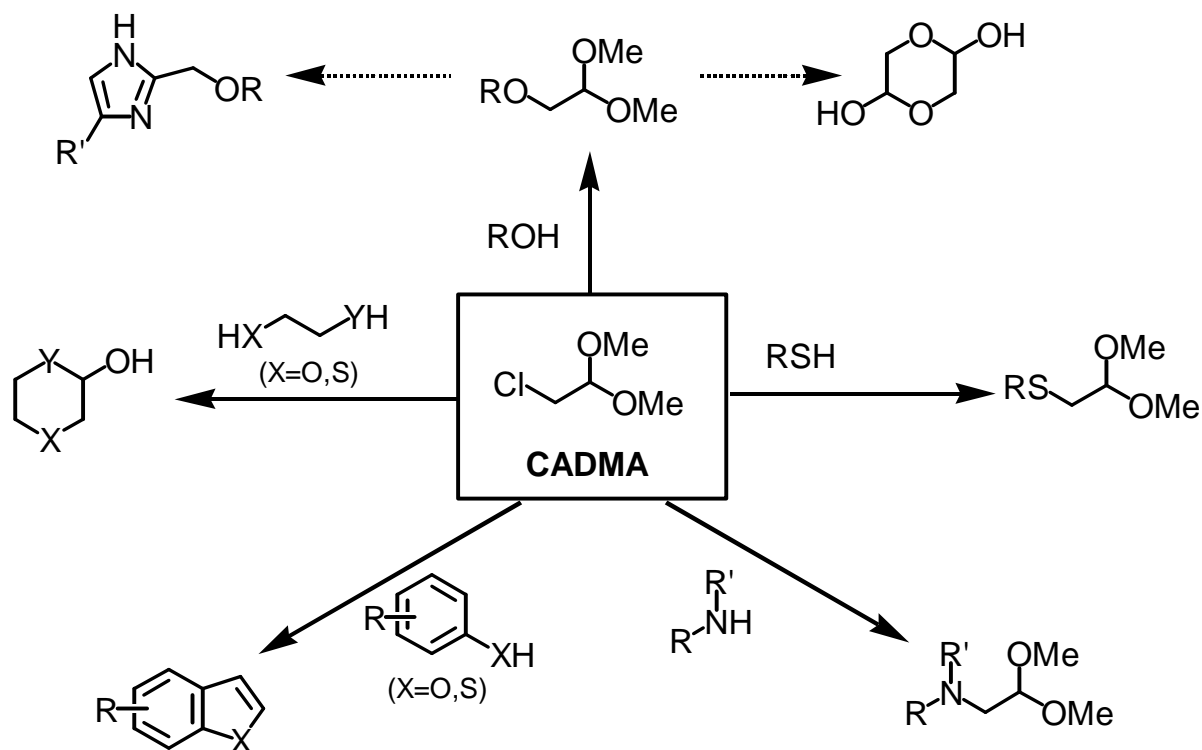


### CADMA



- 2-Chloroacetaldehyde dimethylacetal
- M.W.124.57, B.p.128deg.,F.p.33deg.
- 1,2-Difunctional Compounds

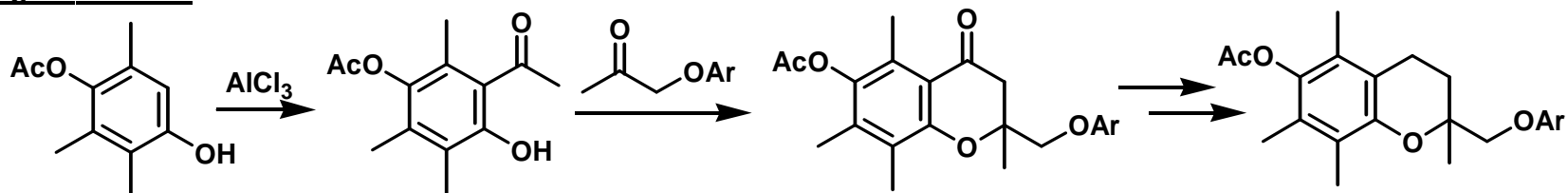
### Useful Building Block !



Kuraray focuses on the design and development of efficient, economical and ecological processes to target compounds.

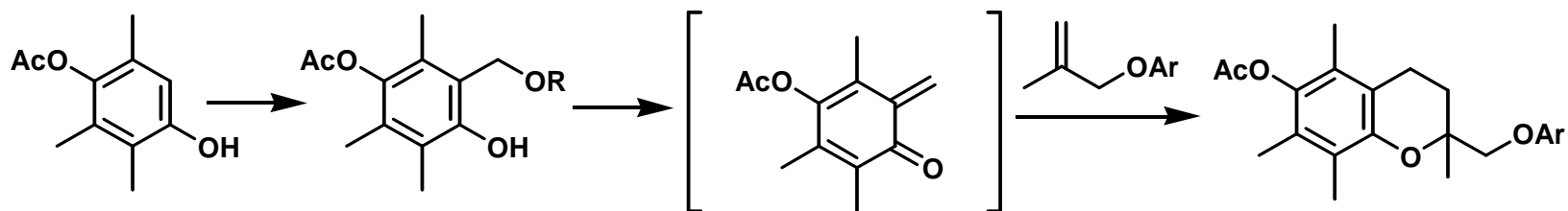
## Example 1 : Chroman Derivatives

### Original Process



### *Formation of Inorganic Salts , 4 Step Process*

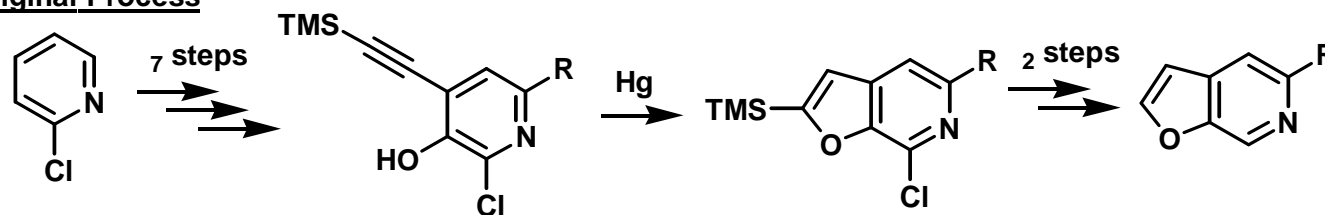
### Kuraray's Process



### *2 Step Process, High Regioselectivity*

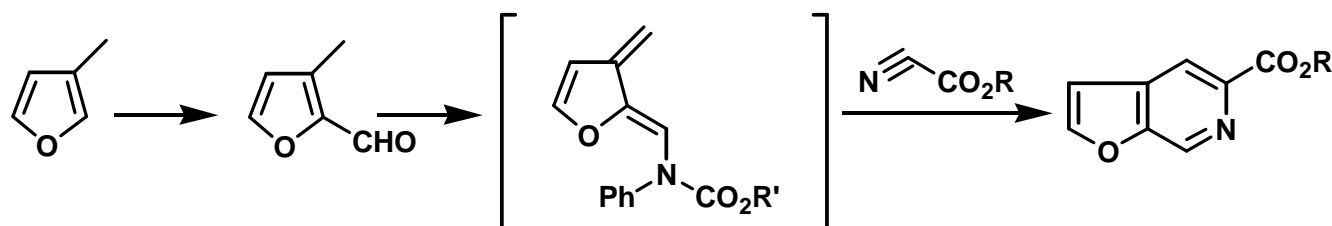
## Example 2 : Furanopyridine Derivatives

### Original Process



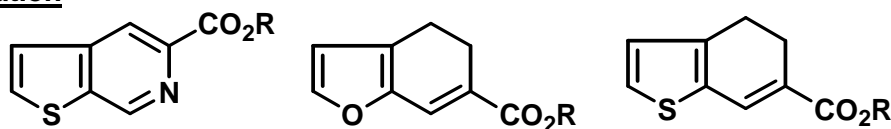
***Multi Step Process, Use of Expensive & Toxic Materials***

### Kuraray's Process



***Short Step Process, High Regioselectivity(No Regioisomer)***

### Application



## Multi Purpose Plant

- MP-1 ; 2 Reactors (6,000L X 2 GL)
- MP-2 ; 3 Reactors (6,000L HC-22 , 10,000L X 2 GL)
- MP-3 ; 2 Reactors (15,000L , 20,000L GL)
- Distillation ; 16 Rectification Columns (Sulzer & Monz Packed)
- Pilot ; 5 Reactors (80L , 200L , 500L , 1,000L GL , 1,000L SUS316)  
1 Centrifuge , 1 Rosenmund Filtration , 1 Distillation Column

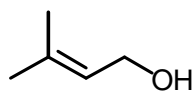
## GMP Plant

- GMP-1 ; 6 Reactors (2,100L , 4,200L X 2 , 6,000L GL, 6,000L X 2 SUS316)  
2 Centrifuges , 1 Dryer
- GMP-2 ; 3 Reactors (100L , 500L X 2 GL)  
1 Centrifuge , 1 Dryer

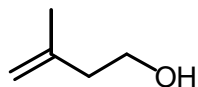
## Other Equipments

- Utility ; Electricity & Steam originated by in-house (Natural Gas)
- Waste Treatment ; Biological Treatment , Incinerator

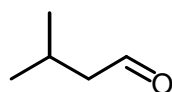
## C5 Derivatives



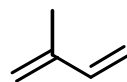
Prenol : C  
CAS No.556-82-1



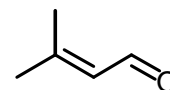
Isoprenol : C  
CAS No.763-32-6



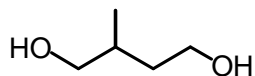
Isovaleraldehyde : C  
CAS No.590-86-3



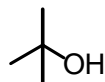
Isoprene : C  
CAS No.78-79-5



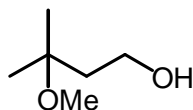
Senecialdehyde : C  
CAS No.107-86-8



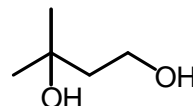
3-Methyl-1,4-butanediol : C  
CAS No.2938-98-9



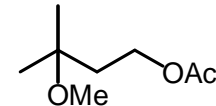
t-Butanol : C  
CAS No.75-65-0



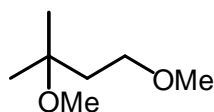
3-Methyl-3-methoxybutanol : C  
CAS No.56539-66-3



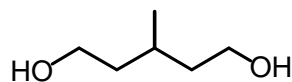
Isoprene glycol : C  
CAS No.2568-33-4



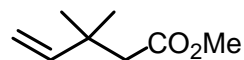
Methyl 3-Methyl-3-methoxybutanoate : C  
CAS No.103429-90-9



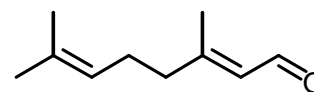
3-Methyl-3-methoxybutylmethylether : L  
CAS No.39836-89-0



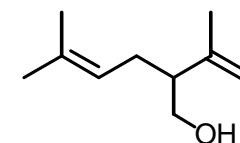
3-Methyl-1,5-pentanediol : C  
CAS No.4457-71-0



Methyl 2,2-Dimethyl-3-butenate : C  
CAS No.63721-05-1

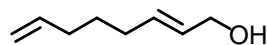


Citral : C  
CAS No.5392-40-5

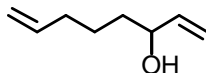


Lavandulol : P  
CAS No.58461-27-1

## C8 Derivatives



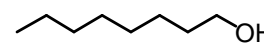
2,7-Octadienol : C  
CAS No.23578-51-0



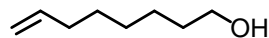
3-Hydroxy-1,7-octadiene : P  
CAS No.30385-19-4



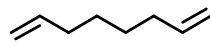
7-Octenal : C  
CAS No.21573-31-9



1-Octanol : C  
CAS No.111-87-5

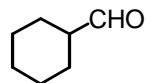


7-Octenol : P  
CAS No.13175-44-5

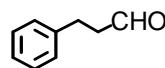


1,7-Octadiene : P  
CAS No.3710-30-3

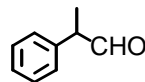
## Transition Metal Catalyzed Reaction



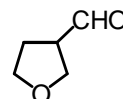
Cyclohexane  
carbaldehyde: P  
CAS No.2043-61-0



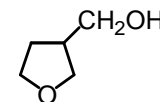
3-Phenylpropanal : C  
CAS No.104-53-0



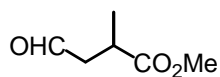
2-Phenylpropanal : C  
CAS No.93-53-8



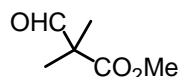
Tetrahydrofuran  
-3-carbaldehyde : P  
CAS No.79710-86-4



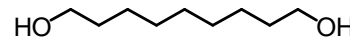
3-Hydroxymethyl  
tetrahydrofuran : L  
CAS No.15833-61-1



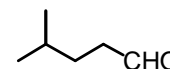
3-Methoxycarbonyl  
butanal : P  
CAS No.13865-21-9



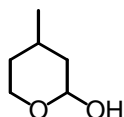
2-Methoxycarbonyl  
-2-methylpropanal : L  
CAS No.13865-20-8



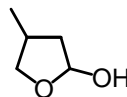
Nonanediol : C  
CAS No.3937-56-2



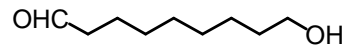
4-Methylpentanal : L  
CAS No.1119-16-0



4-Methyl-2-hydroxy  
tetrahydropyran : C  
CAS No.18653-57-1



2-Hydroxy-4-methyl  
tetrahydrofuran : P  
CAS No.31314-85-7

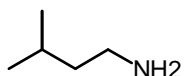


9-Hydroxynonanal : L  
CAS No.22054-15-5

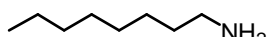


Methyl 3,3-dimethyl-6-  
oxohexanoate : L  
CAS No.183584-06-4

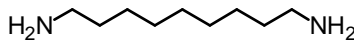
## Selective Hydrogenation & Reduction



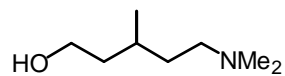
Isoamylamine : P  
CAS No.107-85-7



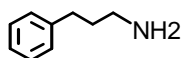
Octylamine : P  
CAS No.111-86-4



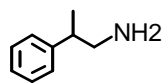
Nonanediamine : C  
CAS No.646-24-2



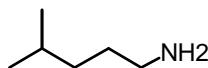
3-Methyl-1-dimethyl  
amino-5-pentanol : P  
CAS No.55424-63-0



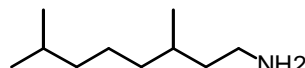
3-Phenylpropylamine : P  
CAS No.2038-57-5



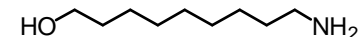
2-Phenylpropylamine : P  
CAS No.582-22-9



4-Methylpentylamine : L  
CAS No.5344-20-7

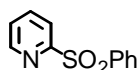


3,7-Dimethyloctylamine: L  
CAS No.13887-74-6

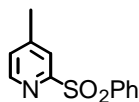


9-Hydroxynonylamine : L  
CAS No.109055-42-7

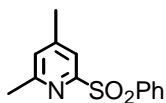
## Diels-Alder Reaction



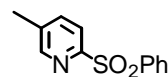
2-Benzenesulfonyl  
pyridine : P  
CAS No.24244-60-8



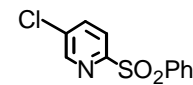
2-Benzenesulfonyl  
-4-methylpyridine : P  
CAS No.2732-35-6



2-Benzenesulfonyl  
-4,6-dimethylpyridine : P  
CAS No.233610-71-4



2-Benzenesulfonyl  
-5-methylpyridine : L  
CAS No.182233-30-3



2-Benzenesulfonyl  
-5-chloropyridine : L  
CAS No.204458-18-4

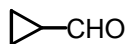
## Other Reaction & Products



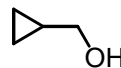
2,5-Dihydrofuran : C  
CAS No.1708-29-8



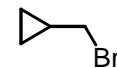
2,3-Dihydrofuran : P  
CAS No.1191-99-7



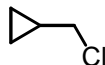
Cyclopropane  
carbaldehyde : P  
CAS No.1489-69-6



Cyclopropyl  
methylalcohol : P  
CAS No.2516-33-8



Cyclopropyl  
methylbromide : P  
CAS No.7051-34-5



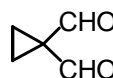
Cyclopropyl  
methylchloride : L  
CAS No.5911-08-0



Cyclobutanol : L  
CAS No.2919-23-5



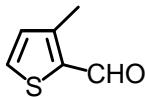
Cyclobutanone : L  
CAS No.1191-95-3



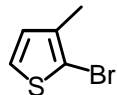
Cyclopropane-1,1-  
dicarbaldehyde : P  
CAS No.136476-41-0



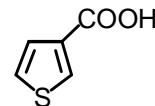
3-Methylthiophene : P  
CAS No.616-44-4



3-Methylthiophene  
-2-carbaldehyde : P  
CAS No.5834-16-2



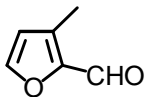
2-Bromo-3-  
Methylthiophene : P  
CAS No.14282-76-9



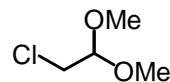
Thiophene-3-  
carboxylic acid : P  
CAS No.88-13-1



3-Methylfuran : P  
CAS No.930-27-8



3-Methylfuran  
-2-carbaldehyde : P  
CAS No.3342-48-2



2-Chloro-1,1-  
dimethoxyethane : C  
CAS No.97-97-2

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