1. 생활용품과 계면현상의 응용

- 세제, 세정제 : 습윤, 침투, 가용화, 분산, 유화, 보호
- 가용화제, 유화제
- 살균, 탈취제 : Quaternary Ammoniums, Betains
- 표면처리제

2. Rinse-Added Fabric Treatment - Fabric Softeners

Benefits of Fabric Softeners?
- Feel Soft
- Freshness : Perfume, Deodor,
- Reduce Static Electricity
- Soil Release
- Anti-Wrinkling
- Easy Ironing
- Fabric Care
Cationic Surfactants as Fabric Softener Ingredient

Dialkyl Dimethyl Amonium Chloride

Diamidoamine Ethoxylated Quaternary Ammonium Methosulfate

Imidazolinium Quaternary Ammonium Methosulfate

Diamidoamine Hydrochloride

— 136 —
### Performance Properties

<table>
<thead>
<tr>
<th></th>
<th>DDMAC</th>
<th>Diamido amine</th>
<th>Imidazoline</th>
<th>Diester Quat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumble-Dry</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Line-dry</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Rewetting</td>
<td>+</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Static Control</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Nonyellowing</td>
<td>-</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

### Silicones as Fabric Softener Ingredient

\[
\begin{align*}
\text{A} & : \quad \text{CH}_3 \quad \{ \text{CH}_3 \} \quad \{ \text{R}^1 \} \quad \{ \text{Si} - \text{O} \} \quad \{ \text{Si} - \text{CH}_2 \} \\
\text{B.1} & : \quad \text{CH}_3 \quad \{ \text{CH}_3 \} \quad \{ \text{CH}_3 \} \quad \{ \text{Si} - \text{O} \} \quad \{ \text{Si} - \text{CH}_2 \} \\
\text{B.2} & : \quad \text{CH}_3 \quad \{ \text{CH}_3 \} \quad \{ \text{CH}_3 \} \quad \{ \text{Si} - \text{O} \} \quad \{ \text{Si} - \text{R} \}
\end{align*}
\]
3. Glass Treatment: Water Repellent and Anti-Fogging

Contact Angle

\[ \gamma_{LV} \] = surface free energy between liquid and vapor (surface tension of the liquid)  
\[ \gamma_{SV} \] = surface free energy between solid and vapor  
\[ \gamma_{SL} \] = interfacial free energy between liquid and solid  
\[ \theta \] = contact angle

Surface Treatment with silicones by Chemical Reaction

Figure 1  A 'Brush' Type Beaded Phase Structure (A)

A 'Brush' Type Beaded Phase Structure (B)

- 139 -
Surface Treatment with Fluoro-silicones by Chemical Reaction

Before Chemical Reaction

- $\text{Si} - \text{O} - \text{Si} - \text{OH}$
  \[ \text{O} \quad \text{O} \quad \text{O} - \text{CH}_2\text{CH}_3 \]
  \[ \text{Si} - \text{O} - \text{Si} - \text{OH} \quad \text{CH}_3\text{CH}_2\text{O-Si-CH}_2\text{CH}_2(\text{CF}_2)_2\text{CF}_3 \quad \text{O-CH}_2\text{CH}_3 \]
  \[ \text{Si} - \text{O} - \text{Si} - \text{OH} \]

After Chemical Reaction

- $\text{Si} - \text{O} - \text{Si} - \text{O-Si-CH}_2\text{CH}_2(\text{CF}_2)_2\text{CF}_3$
  \[ \text{O} \quad \text{O} \quad \text{O} \]
  \[ \text{Si} - \text{O} - \text{Si} - \text{O-Si-CH}_2\text{CH}_2(\text{CF}_2)_2\text{CF}_3 \quad \text{O} \quad \text{O} \quad \text{O} \]
  \[ \text{Si} - \text{O} - \text{Si} - \text{O-Si-CH}_2\text{CH}_2(\text{CF}_2)_2\text{CF} \]

---

- 140 -
4. Fuel System Treatment: Gasoline and Diesel Additives

Location and Effects of Deposit

![Diagram showing the location and effects of deposit in a fuel system.]

- Camshaft
- Cylinder
- Exhaust Valve
- Intake Valve
- Piston
- Exhaust Valve Deposits
- Intake Valve Deposits
- Injector Plunger Deposits
- Combustion Chamber Deposits
- Driveability
- Power Loss
- Exhaust Emissions
- Fuel Economy
- Octane Requirement Increase
- Exhaust Emissions
- Deposit Interference

Composition of Multi-purpose Additives

- Corrosion Inhibitor
- Detergent
- Dispersant
- Carrier Fluid
- Demulsifier

Additive Package
Detergents and Dispersant for Fuel Additives

- PIB-Amine
  \[ \text{CH}_{3} \text{CH}_{2} \text{CH}_{2} \text{NHCH}_{2} \text{CH}_{2} \text{CH}_{2} \text{CH}_{2} \text{NH}_{2} \]

- PIB-Succinimide
  \[ \text{CH}_2\text{NHCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_{2} \]

- PIB-Mannich Base
  \[ \text{CH}_2\text{NR} \]

- Polyether Amine
  \[ \text{CH}_x \text{CH}_2 \text{O} \]

---

Detergent and Dispersant Action

- Detergent
- Dispersant
Additive Development

1997 - 2000
1997 - 1998
1996 - 1997
Mid 1990's
Late 1980's
1980's
1970's
1950 - 1960's

Emissions Reduction
Direct Injection
Exhaust Valve Sticking
Combustion Chambers
Intake Valves
Fuel Injectors
Carburetor Cleanliness
Carburetor Icing and Corrosion

Evolution of Concerns
Corrosion Inhibitors Protecting Metal Surface

Chemical Structure of a Typical Demulsifier

\[(\text{EtO})_3\text{(PrO)}_4\text{OH}\]

\[R = \text{C}_6\text{H}_4\text{C}_{10}\]
4. Engine Oil Additives

Additive Package

A Mannich Type Dispersant

A.

\[
\text{POLYSBUTYLENE} \quad + \quad \text{MALEIC ANHYDRIDE} \quad \rightarrow \quad \text{AN ASAA}
\]

B.

\[
\text{AN ALKYPHENOL} \quad + \quad \text{A MONO-SUCCINIMIDE DISPERSANT} \quad \rightarrow \quad \text{A MANNICH TYPE DISPERSANT}
\]
A Overbased Detergent

NORMAL CALCIUM SULFONATE (NCS)

OVERBASED CALCIUM SULFONATE MICELLE
(WHERE $\sim_o$ = NCS)

Anti-Ware and Extreme Pressure Agents

- Anti-Ware Agent
- Extreme Pressure Agent
- Friction Modifiers (Friction Reducers)
- Antioxidants
Organo-Molybdenum Compounds (OMC)

\[
\begin{array}{c}
\text{RO} \quad \text{S} \quad \text{Mo} \quad \text{S} \quad \text{Mo} \quad \text{S} \quad \text{OR} \\
\text{RO} \quad \text{S} \quad \text{N} \quad \text{MoxOyH} \\
\text{R: Alkyl radical}
\end{array}
\]

Mo-dithiophosphate (Modtp)  
Decomposition Temperature  
150 °C ~ 200 °C

Mo-Amine (Mo-Amn)  
Decomposition Temperature  
230 °C

Mechanism on Lubrication of OMC on Metal Surface

OMC

Sulfur Source e. g. ZnDTP

\[\text{Tribochemical Reaction (rubbing/ temp. / pressure)}\]

\[\text{Metal Surface} \]

\[\text{MoS2 Layer} \]

\[\text{Metal Surface} \]

- 148 -
SRV Test for Friction Coefficient

SRV Tester

1. Load 200 N
2. Amplitude 1.0 mm
3. Frequency 50 Hz
4. Temperature 80 °C
5. Test Period 15 min
6. Cylinder & Plate
   - Cylinder Ø15 × 22 mm
     SUJ-2 (AISI-52100)
   - Plate Ø24 × 6.8 mm
     SUJ-2 (AISI-52100)
     Ra=0.16 μm
#Fmax (Hertz Theory)=209Mpa
#SUJ-2: High Carbon Chromium Bearing Steel (760HV)

SRV Test Results
Four Ball Test Results

[Graphs showing test results for different types of engine oil, with labels for oil types and test duration from 0 to 1500 rpm.]