KONASIL

Fumed Silica

March, 2011

OCI Company Ltd.

Contents

OCI company profile

○ **Established in 1959, around 50 years of chemical business experience**

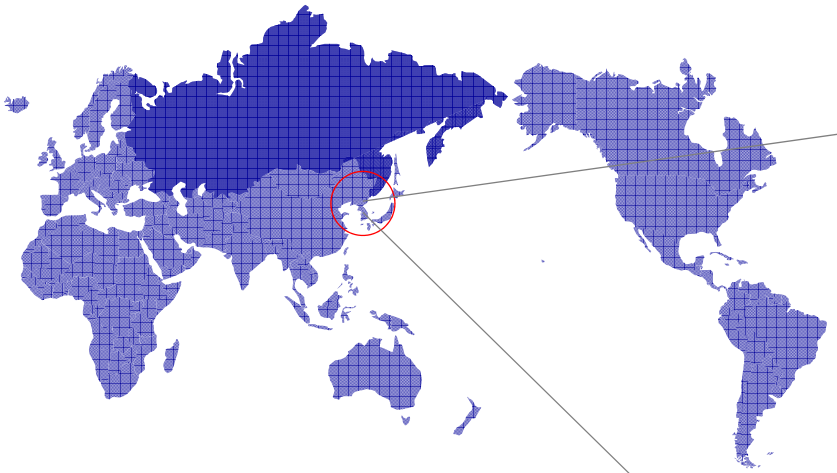
- ✓ **Basic Chemicals : Soda Ash, Calcium Chloride, Sodium Chlorite, Phosphoric Acid, Caustic Soda, Hydrogen Peroxide, Sodium Carbonate Peroxyhydrate, Fumed Silica, etc.**
- ✓ **Fine & Specialty Chemicals : Reagents, etc.**
- ✓ **Petrochemicals : TDI, PVA, Acetic Acid, etc.**
- ✓ **Coal Chemicals : Carbon Black, Pitch, BTX, Phthalic Anhydride, etc.**
- ✓ **Renewable Energy : Polysilicon**

○ **Employees('10) : 3,800 persons**

○ **Performance in 2010**

- ✓ **Sales Revenue : US$ 2,255 million**
- ✓ **EBITDA : US$ 808 million (36%)**

Production sites



● Headquarter
▲ Plant
◆ R & D Center

■ Kunsan Plant

TDI	**50,000 MTPA**
Polysilicon	**26,500 MTPA**
Fumed silica	**9,000 MTPA**

■ Pohang Plant

Carbon black	100,000 MTPA
BTX	70,000 MTPA
Phthalic Anhydride	78,000 MTPA
Pitch	110,000 MTPA

■ Kwangyang Plant

BTX	180,000 MTPA
Pitch	90,000 MTPA
Carbon black	100,000 MTPA

■ Incheon Plant

Calcium chloride	30,000 MTPA
Sodium Chlorite	7,000 MTPA
Reagents	

■ Iksan Plant

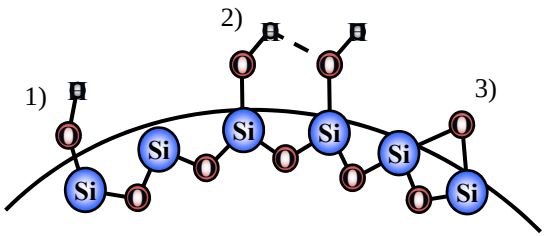
Hydrogen peroxide	70,000 MTPA
Sodium carbonate peroxyhydrate	40,000 MTPA

Introduction of KONASIL

Brand Name : Korea + Nano + Silica

Silicon Dioxide

-. SiO2 (M.W. = 60.08)
-. White, fluffy powder
-. Primary particle size (7-20nm)
-. Aggregate(0.2 ~ 0.5㎛) or Agglomerates (less than 44㎛)
-. Large surface area, High purity, Chain-like structure



1) Isolated silanol
2) Vicinal silanol
3) Siloxane bond

Surface of Untreated Fumed Silica

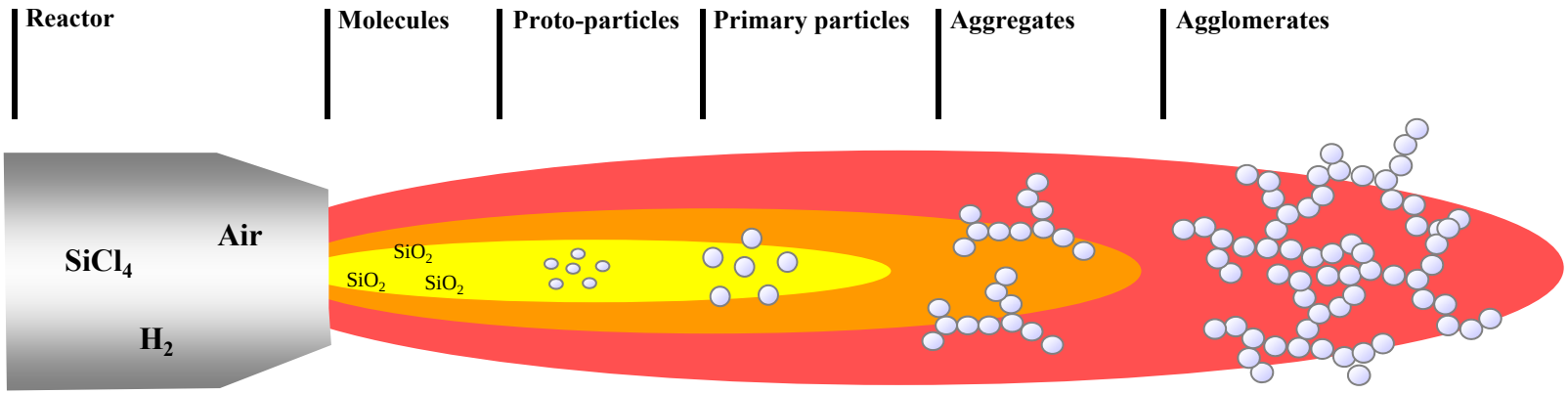
-. 3 types of surface hydroxyl on silica
-. hydrophilic
-. 2 ~ 4 (Si-OH)/nm^2

History of KONASIL

Fig. The foreground of the Fumed Silica Plant

1996. 2	Manufacturing technology development
1999. 6 ~ 2000. 4	Bench scale test in R&D center
2004. 6	Pilot test in Gunsan plant
2005. 7	Plant construction, Capa' 3,000MT/y
2006. 6 ~ 2007.11	*PCS pilot production*
2008. 2	1st Expansion, Capa' 6,000MT/y
2008. 3	*PCS 1st Expansion, Capa' 6,500MT/y*
2009. 6	2nd Expansion, Capa' 9,000MT/y
2009. 7	*PCS 2nd Expansion, Capa' 16,500MT/y*
2010.12	*PCS 3rd Expansion, Capa' 26,500MT/y*
2012. 6(E)	China FS Plant, Capa' 6,000MT/y

Manufacture



$$SiCl_4 + 2H_2 + O_2 \rightarrow SiO_2 + 4HCl$$

* Primary Particle :molten spheres of silicon dioxide
* Aggregate : 3-dimensional branched chains
* Agglomerate : mechanical entanglement of aggregate chains

General Product Description

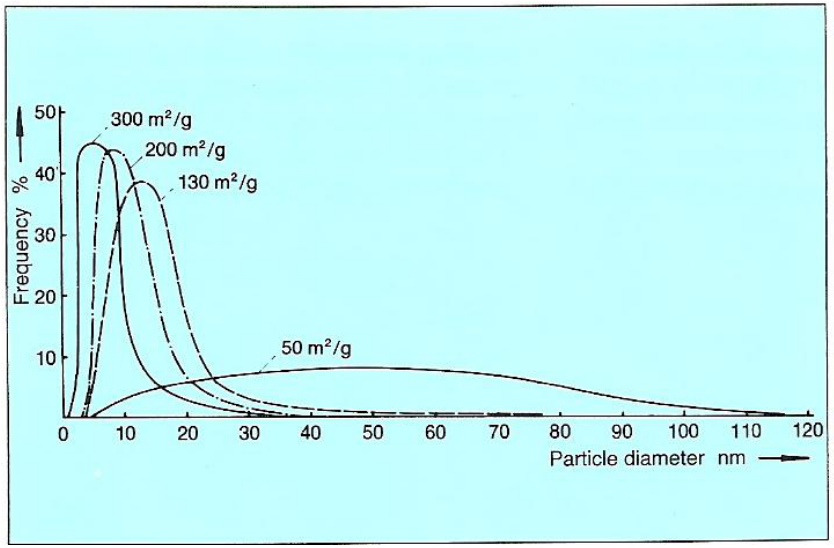


Fig. Particle size distribution of KONASIL with various surface area.

Fig. Thirty grams of K200 have the same surface area as a soccer field.

Table. Primary Particle Size & Surface Area

Properties	K-90	K-150	K-200	K-300
Primary Particle size (nm)	20	14	12	7
Surface Area (m²/g)	90	150	200	300

Surface Chemistry

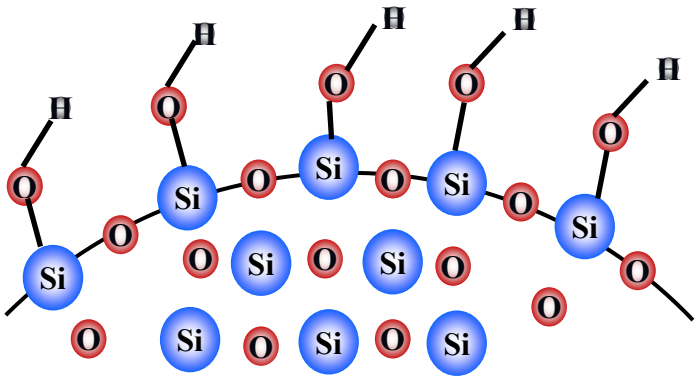


Fig. Representation of a hydrophilic KONASIL particle

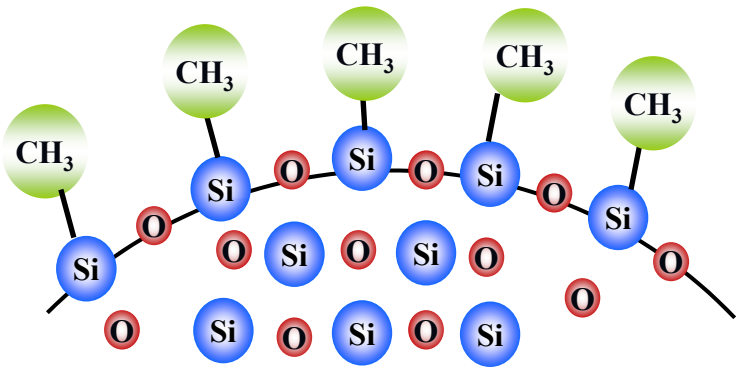


Fig. Representation of a hydrophobic KONASIL particle

Morphology

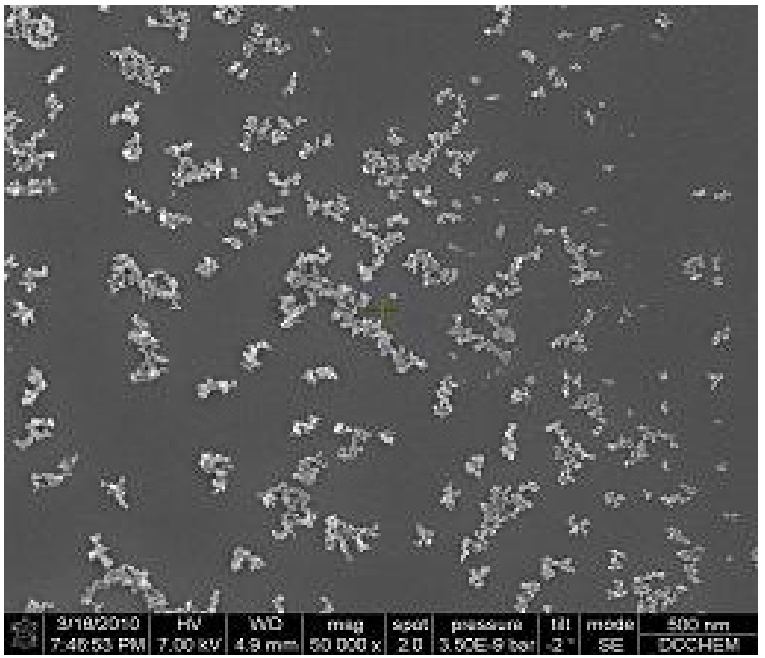


Fig. SEM image of KONASIL.

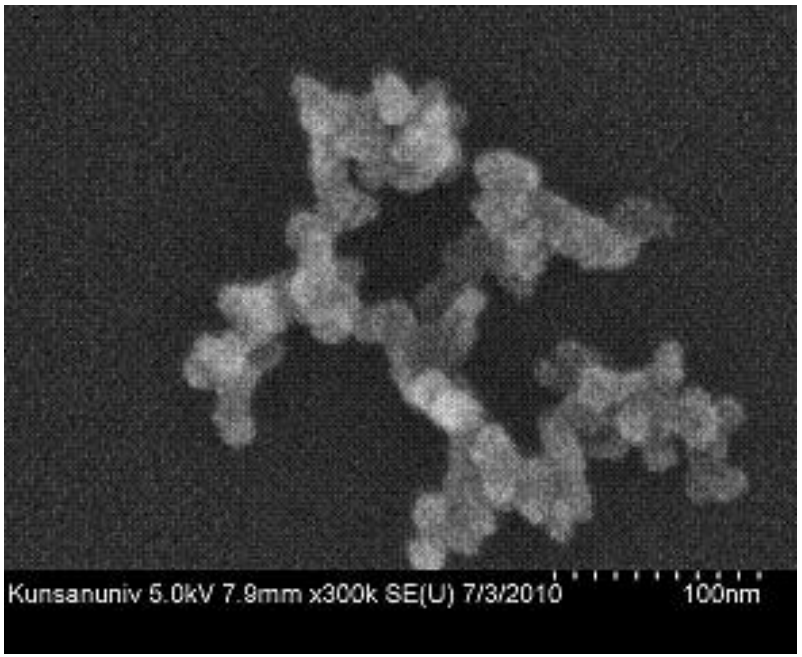


Fig. FE-SEM image of KONASIL.

Packaging and Handling

Paper bag

Size(mm) : 500 *1110*220 mm
Material : Pulp Pulp + P.E. coating(3 Layers)
Loading Quantity : 200kg(10kg/bag * 20bag)

Ton Bag

Size(mm) : 1100*1100*2000 mm
Material : P.P.(Internal Coating)
Loading Quantity : 200 kg (Densified FS)

Bulk Container

Size(mm) : 2400*2400*11900 mm
Material : P.E.
Loading Quantity : 4,500~5,000kg(Densified FS)

Characteristic properties of individual KONASIL types

KONASIL 90	**Fumed silica having a low surface area for CMP slurry.**
KONASIL 150	**Fumed silica for Thickening, structuring and reinforcing of room temperature curing sealing compounds.**
KONASIL 200	**Most frequently used KONASIL type for thickening, thixo-tropy, and reinforcement. Another widespread application is that of improving the free flow of powder substances.**
KONASIL 300	**The high specific surface area gives an enhanced thickening and thixo-tropic effect. One important use is in heat-cured silicone rubber.**

Technical Data for KONASIL Types_Standard Types

Typical Properties	unit	K-90	K-150	K-200	K-300
BET Surface Area	m^2/g	90 ± 15	150 ± 20	200 ± 25	300 ± 30
pH value *1	-	3.7-4.7	3.7-4.7	3.7-4.7	3.7-4.7
Drying Loss *2	wt.%	≤ 1.0	≤ 1.0	≤ 1.5	≤ 1.5
Ignition Loss *3	wt.%	≤ 1.0	≤ 1.0	≤ 1.5	≤ 2.0
Tap Density Standard	g/l	50	50	50	50
Sieve Residue *4	%	< 0.05	< 0.05	< 0.05	< 0.05
HCl	wt.%	< 0.025	< 0.025	< 0.025	< 0.025
Al_2O_3	wt.%	< 0.05	< 0.05	< 0.05	< 0.05
Fe_2O_3	wt.%	< 0.003	< 0.003	< 0.003	< 0.003
TiO_2	wt.%	< 0.03	< 0.03	< 0.03	< 0.03

*1 in 4 % aqueous dispersion
*2 dried for 2 hours at 105℃
*3 dried for 2 hours at 1000℃
*4 325 mesh(44micron) residue max.

Equivalent of KONASIL Grades

Contents	type	Hydrophilic Grade			
		90	150	200	300
OCI KONASIL	Standard	K90	K150	K200	K300
	Densified	K90D	K150D	K200D	K300D
Cabot CAB-O-SIL	Standard	L90	LM150	M5 HP60	H5
	Densified	-	LM150D	M7D	-
Wacker HDK	Standard	C10	V15	N20	T30
	Densified	-	V15P	N20P	-
Evonik AEROSIL	Standard	A90	A150	A200	A300
	Densified	-	A150V	A200V	A300V
Tokuyama REOLOSIL	Standard	QS09	QS10	QS102 QS-20(L)	QS30
	Densified	-	QS10C	CP102	QS30C

Equivalent of hydrophobic KONASIL Grades

Contents	OCI		Evonik		Cabot		Wacker		Tokuyama	
	Grade	SA	Grade	SA	Grade	SA	Grade	SA	Grade	SA
DDS	K-D15	120±20	R-972 R-974	110±20 170±20	TS-610	125	H13 H15 H20 H30	special 150±20 200±30 300±30	DM-10 DM-30	120±20 230±20
HMDZ	-	-	R-8200 R-812S R-812	160±25 220±25 260±30	TS-530	225	H2000/ H20RM H30RM	200±30 300±30	HM-20L ZD-30ST HM-30S	150±20 190±20 200±20
D4	K-T30	230±30	R-104 R-106	150±25 250±30	TS-340 TS-240	150 250	-	-	KS-20SC	160±20
PDMS	K-P15 K-P20	100±20 120±20	R-202 RY-200	100±20 100±20	TS-720	115	H-17 H-18	150±20 200±30	PM-20L	100±20
MTCS	-	-	-	-	-	-	-	-	MT-10	120±20

Commercial Production will be started in Jan. 2012

Technical infra-structure

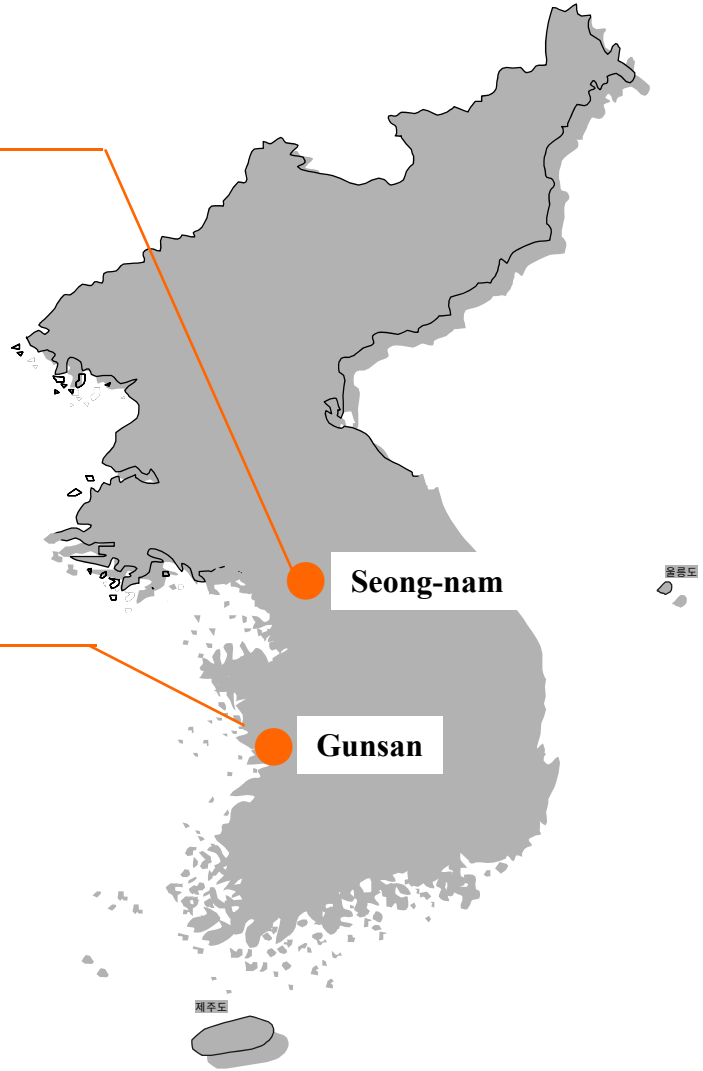
■ **Seong-nam R/D center**

- **Manpower**

  Ph D. (15), M.S (40), B.S (16), Oters (16)

■ **Gunsan Plant**

- **Quality Assurance Team**
- **Production &Technology center**



Analysis & Testing instruments

1. Organic Analyzer

FT-NMR (Nuclear Magnetic Resonance),
GC (Gas Chromatography), GC-AED, Head Space & GC, GC-MASS
HPLC (High Performance Liquid Chromatography), Prep-LC (Preparative LC)
FT-IR (Fourier Transform Infrared Spectroscopy)
UV (UV Visible Spectroscopy), Gas-Mass
EA(Elemental Analyzer),
TOC-TN Analyzer

2. Inorganic Analyzer :

ICP-Mass (Inductively Coupled Plasma Mass Spectrometer), ICP
AA (Atomic Absorption Spectrometer)
I.C(Ion Chromatography)
Mercury Analyzer

3. Polymer Analyzer :

GPC (Gel Permission Chromatography)
Light Scattering
UTM (Universal Testing Machine)
Rheo-meter

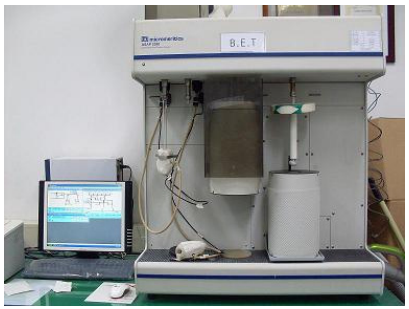
4. Surface Analyzer :

SEM-EDX(Scanning Electron Microscope)
AFM (Atomic Force Microscope)
XRD(X-ray Diffractometer), Polarization micros

5. Thermal Analyzer :

DSC (Differential Scanning Calorimeter)
TGA (Thermogravimetric Analyzer)

Analysis instruments



BET (Micromeritics)

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ICP-OES(Thermo)

Particle size analyzer

Large particle counter

Micro-fluidizer

H-NMR(Bruker)

SEM (JEOL)

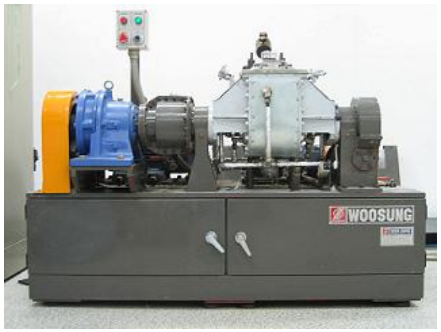
Equipments for application test

Ross Mixet

Brookfield viscosity

UTM (Shimazu)

Density meter



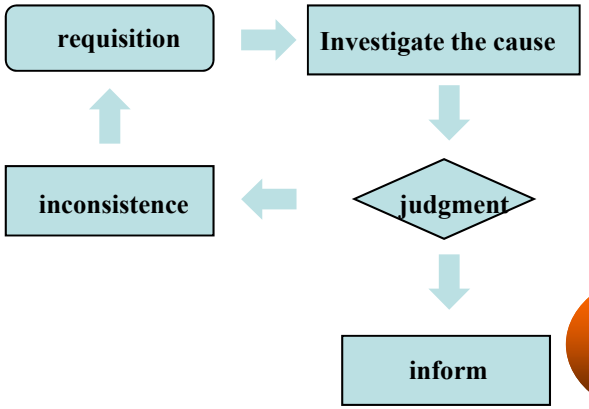
5L Kneader

Two-roll Mill

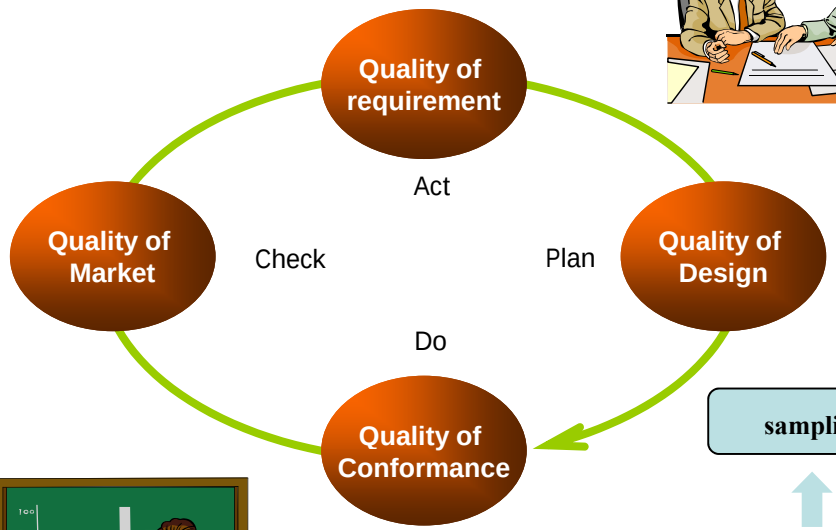
Hot Mold Press

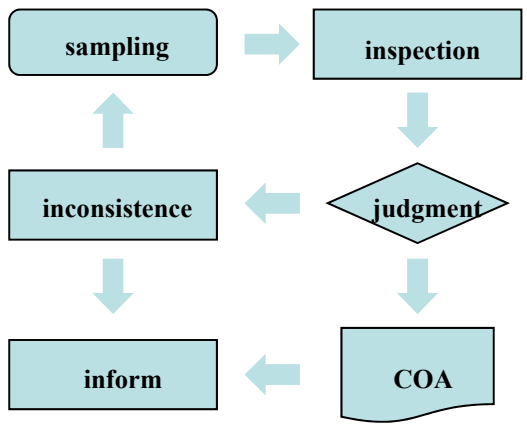
Rheometer

Quality Assurance system



Handling process of Complaint





Inspection & management process