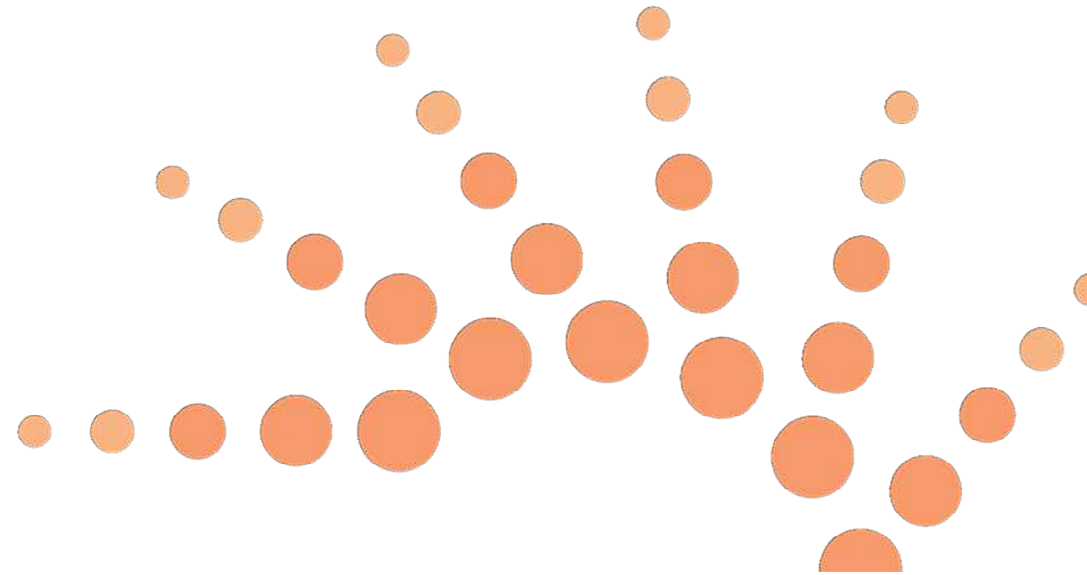


Hanwha Chemical

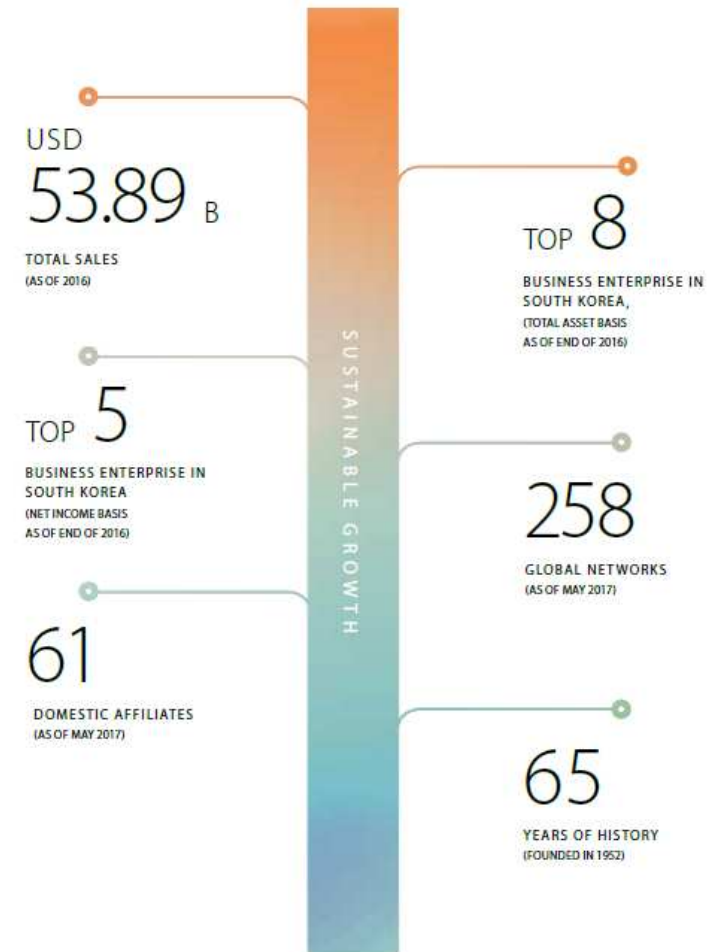
Hydrogenated Hydrocarbon Resin



Hanwha's Today

“Since our founding in 1952, Hanwha has grown into a Fortune Global 500 company.

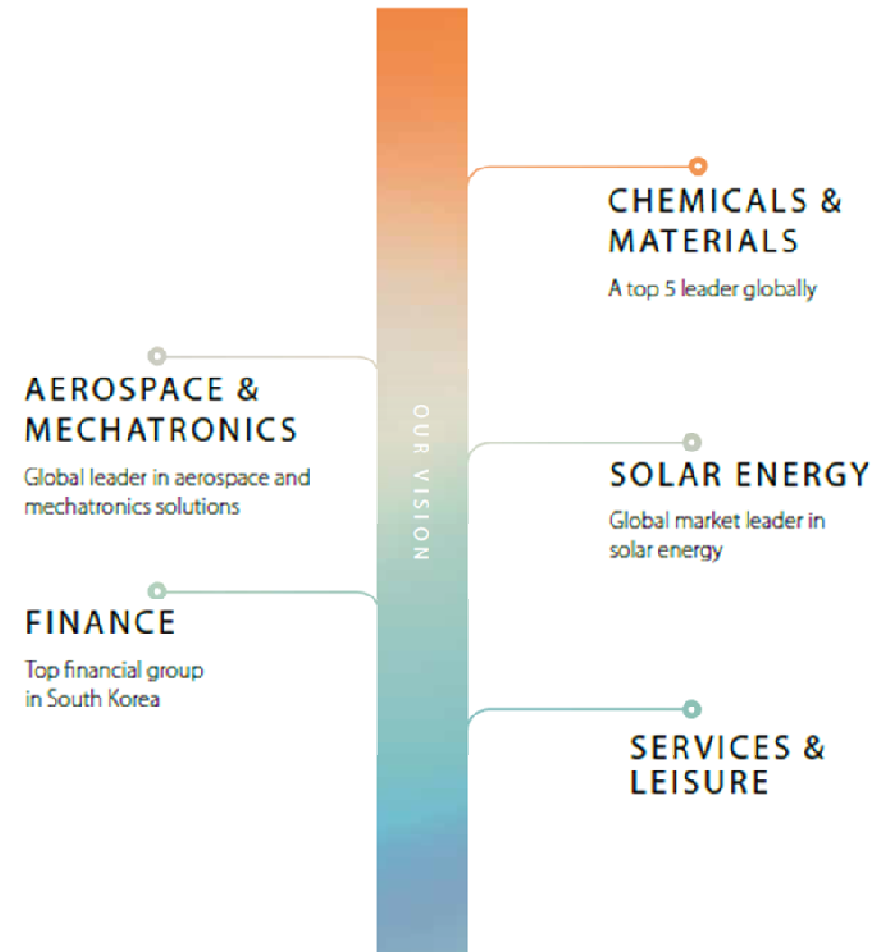
Our business expertise and synergies in manufacturing, construction, finance, service and leisure have made us the 8th largest business enterprise in South Korea.”



Hanwha's Businesses and Vision

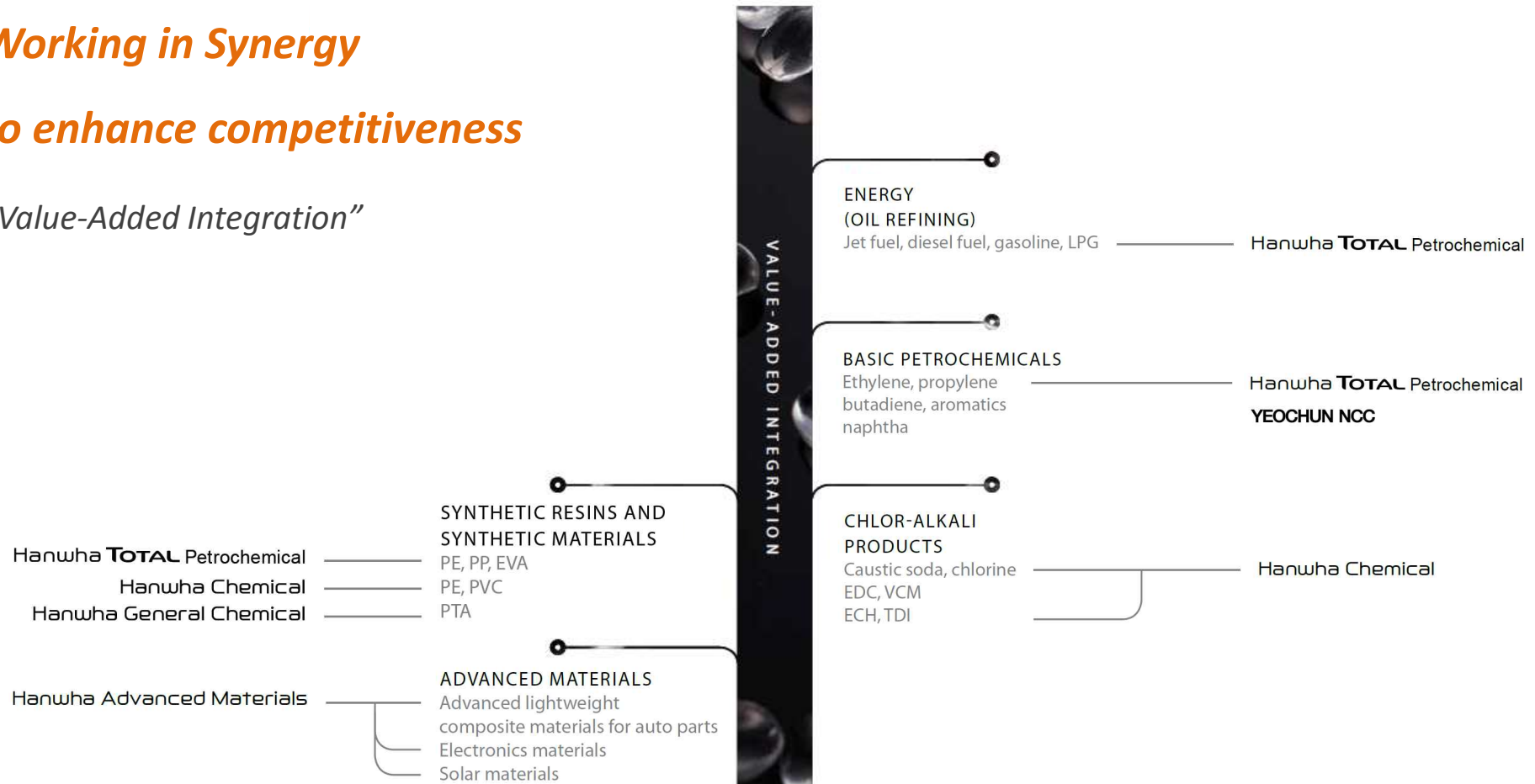
"Our vision is to touch the lives of every individual in every country in which we operate.

We want to elevate the quality of life with our innovations and solutions"



Working in Synergy to enhance competitiveness

“Value-Added Integration”



Hanwha Chemical

Hanwha Chemical has been at the forefront of Korea's advancements in the chemical industry.

Starting with Korea's first production of PVC, we began producing a full array of basic petrochemical products including LDPE, LLDPE, and CA, all of which has since served as base products across a wide range of industries.



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Business Overview



We developed our own, “polymerization-hydrogenation system” and “hydrogenation catalyst”.

Hanwha Chemical Hydrocarbon Resin

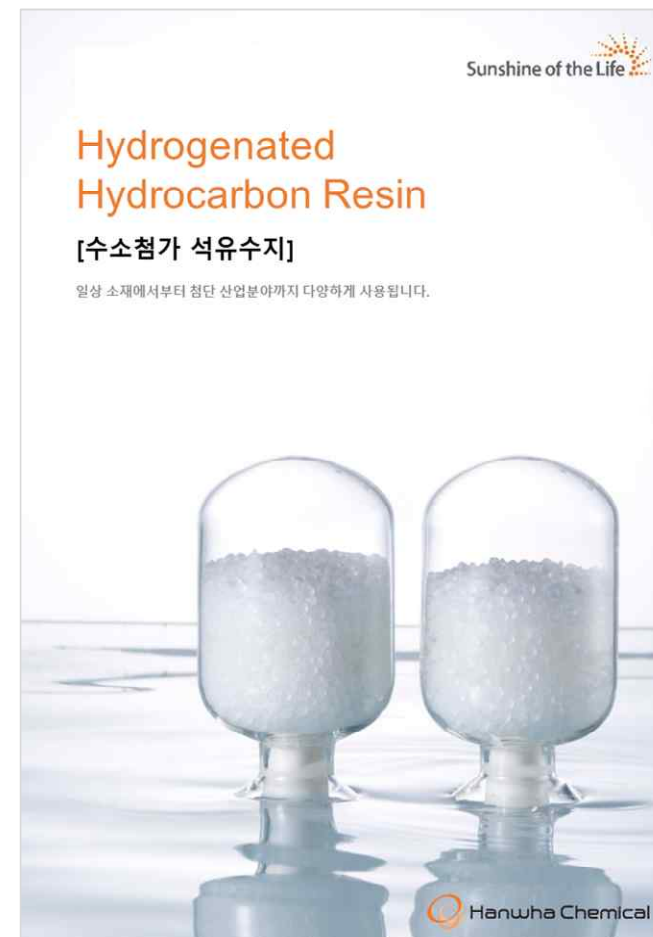
Hydrocarbon resin Line-up

Softening Point	DCPD	DCPD-C9 modified	
90°C	HC-90		
100°C	HC-100	HS-100	HP-100
120°C	HC-120	HS-125	
130°C	HC-130		PP-140

* Orange: '19.08 launch, Black: '20.08 launch (Scheduled)

Applications

Applications		Polymer	HCC Grades
HMA	Packaging Filter Assembly Bookbinding, Etc.	EVA APAO me-PO	HC-90, HC-100, HC-120, HC-130, HS-100, HS-125, HP-100
HMP SA	Hygiene Labeling Patch, Etc.	SBS, SIS SEBS me-PO	HC-90, HC-100, HC-120, HS-100, HS-125, HP-100
Modified BOPP Film	Twist-wrap film Shrink over wrap-film	PP	PP-140



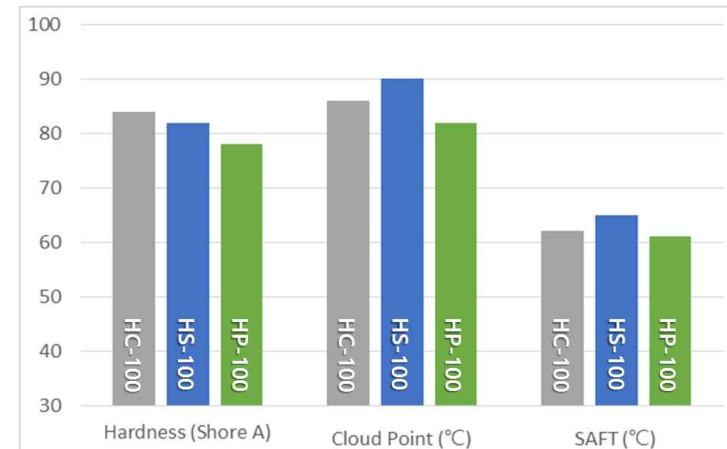
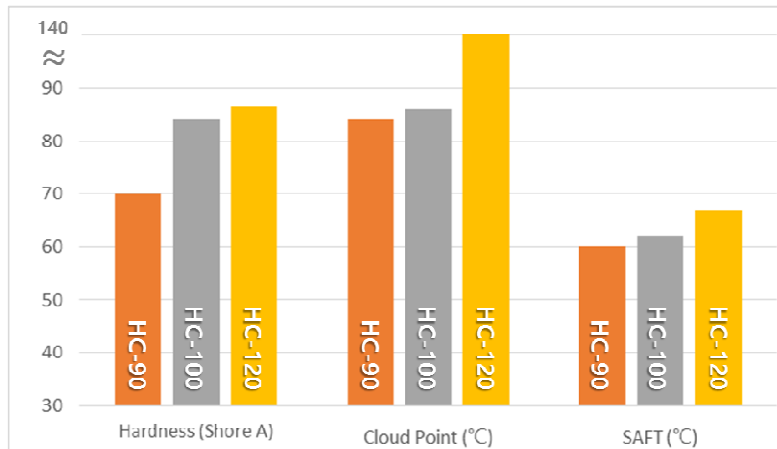
Technical Data Sheet

Hanwha Chemical developed a *colorless and transparent* hydrogenated hydrocarbon resin(H-HCR) with *low odor, excellent thermal stability and well-balanced adhesive properties.*

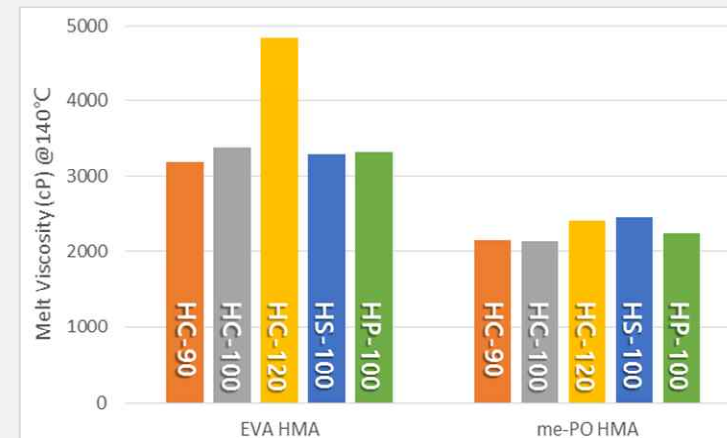
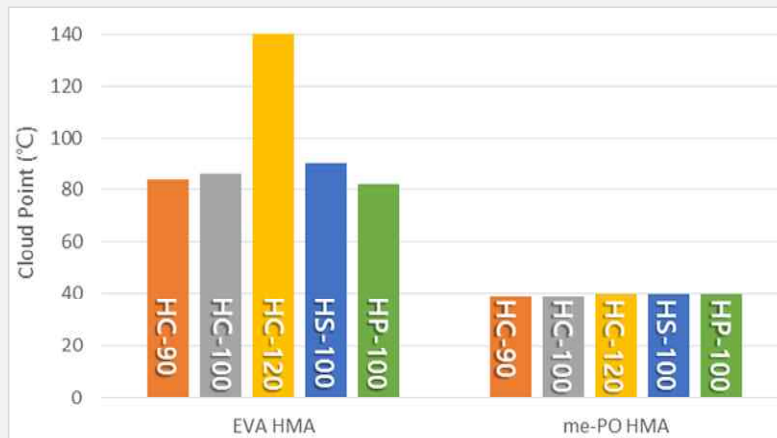
Properties	Test Method	HC-100	HC-120	HS-100	HP-100
Softening Point (°C)	Ring and ball	103	120	103	101
Color (50% toluene solution)	APHA (HAZEN)	20	20	20	<25
Thermal Stability (180°C, 72hrs)	Gardner #	8	8	8	<17
Melt Viscosity (cP)	BRF @180°C	200	800	230	200
Molecular Weight (Mw)	GPC	420	540	530	790
Aromatic double bond contents (%)	H-NMR	<1	<1	<1	9

HMA for Packaging Application

EVA HMA formulation *EVA (VA 28%, MI 400) : Tackifier : Wax = 35:50:15



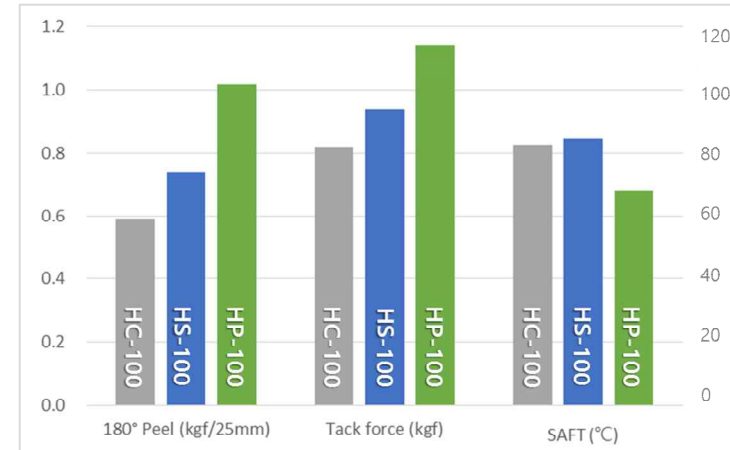
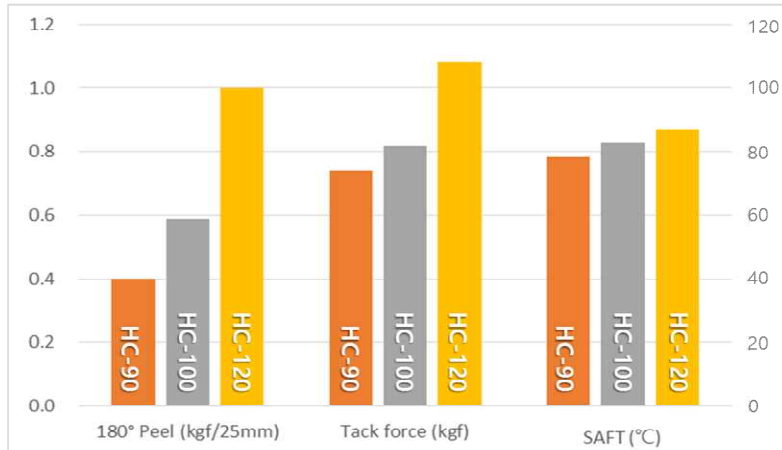
Me-PO HMA formulation * GA-1950 : Tackifier : Wax = 35:35:30



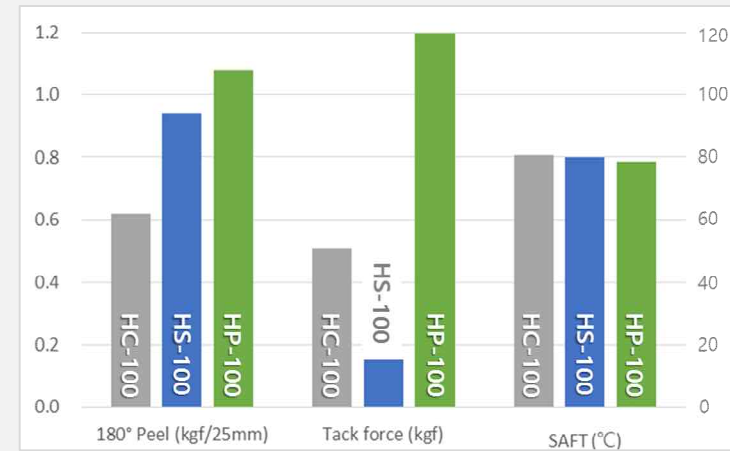
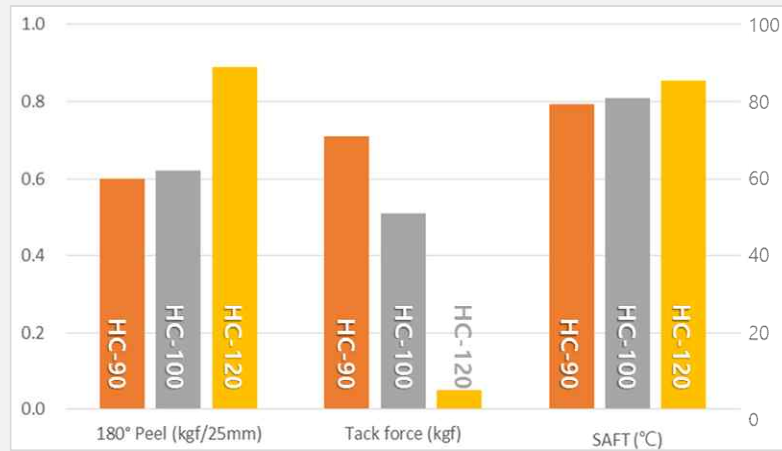
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HMPSA for Hygiene Application

SIS HMPSA formulation * SIS (SM 15%, Di-block 18%) : Tackifier : Oil = 25:57:18



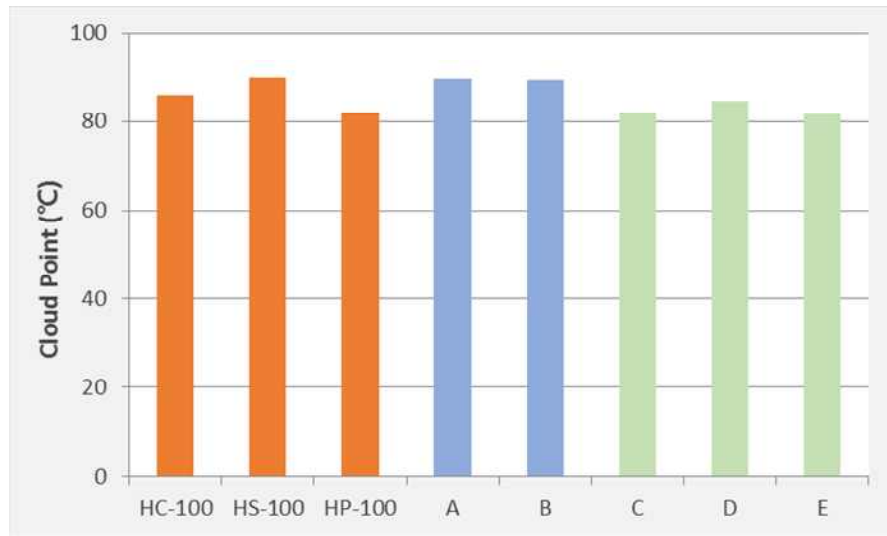
SBS HMPSA formulation * SBS (SM 40%, Di-block <1%) : Tackifier : Oil = 25:57:18



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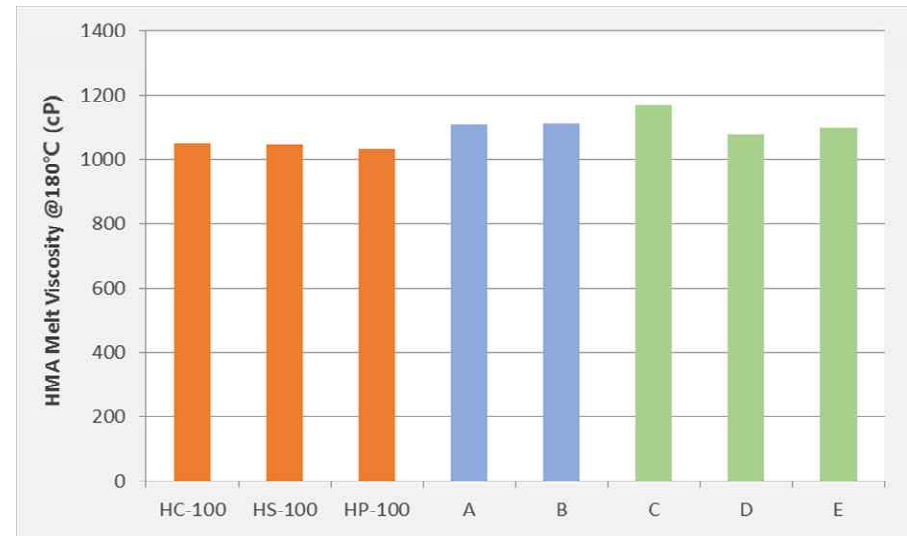
Property Comparison

HMA cloud point



* EVA (VA 28%, MI 400) : Tackifier : Wax = 40:40:20

HMA melt viscosity






* EVA (VA 28%, MI 400) : Tackifier : Wax = 40:40:20

Our products represent the similar general properties compared with competitors.

The Strengths of Our H-HCR: **Thermal Stability**

Color Change after Thermal Aging

Sample	Hanwha Chemical	Competitor 1	Competitor 2
Thermal Aged Color			

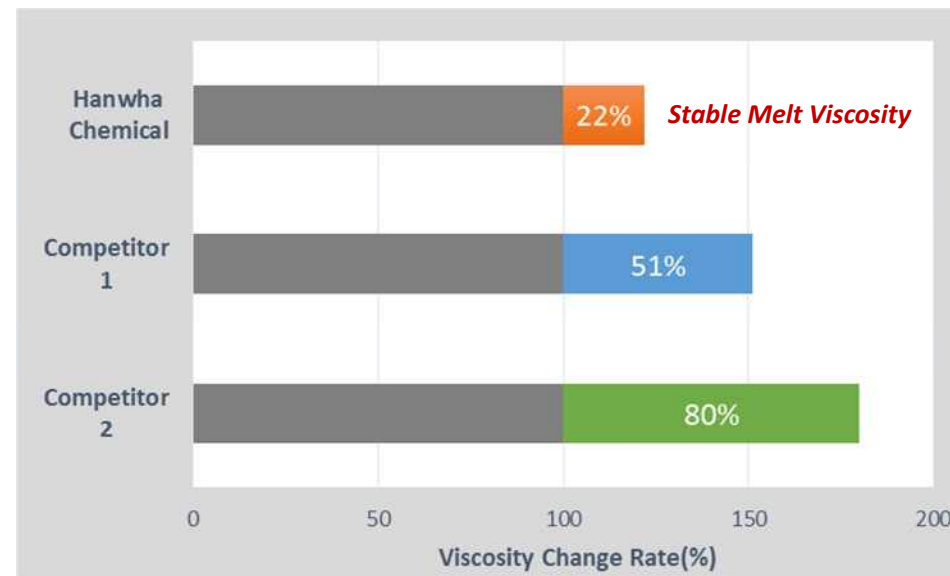
* Tackifier Only; 180°C, 72hr aging

New *polymerization-hydrogenation system*
and our own *hydrogenation catalyst*



Our own technologies make the good thermal stability without anti-oxidant increasing.

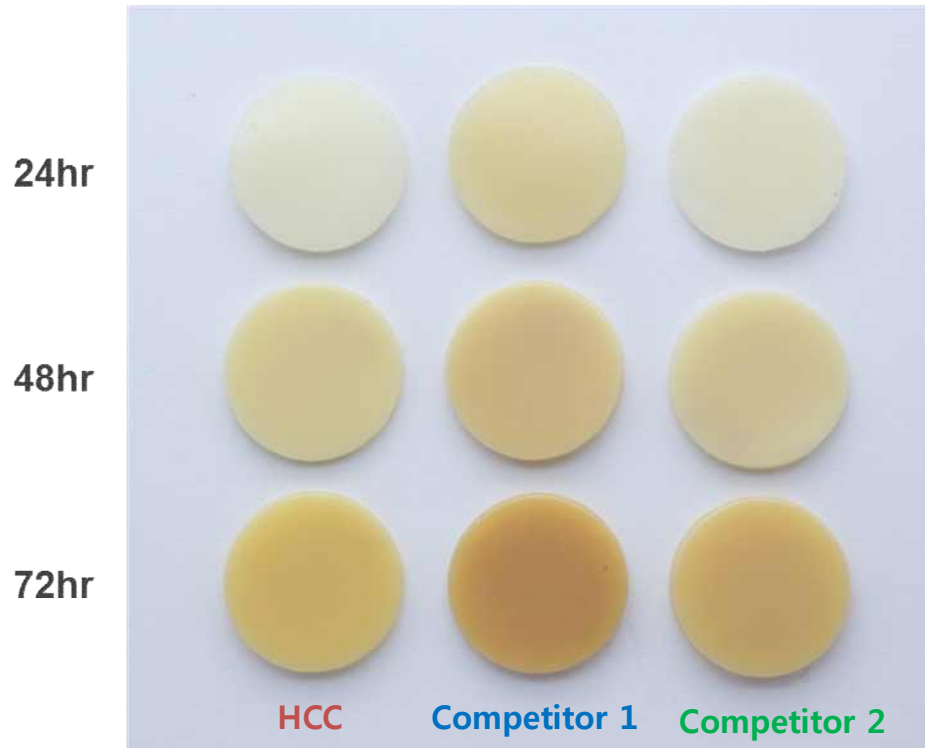
Viscosity Change Rate after Thermal Aging



* Tackifier Only; 180°C, 72hr aging

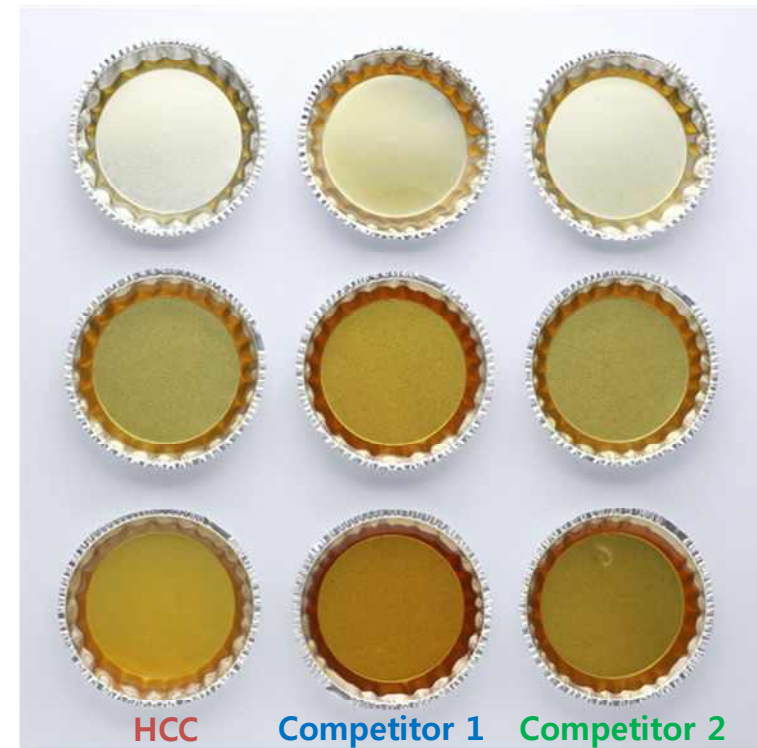
The Strengths of Our H-HCR: **Thermal Stability**

Packaging EVA HMA Formulation



* EVA (VA 28%, MI 400) : Tackifier : Wax = 40:40:20

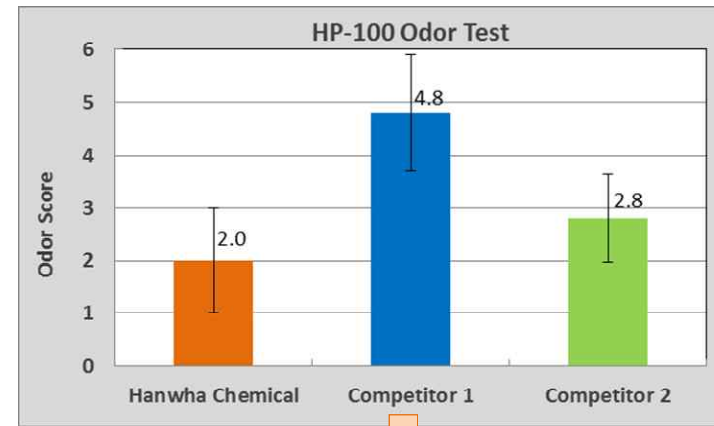
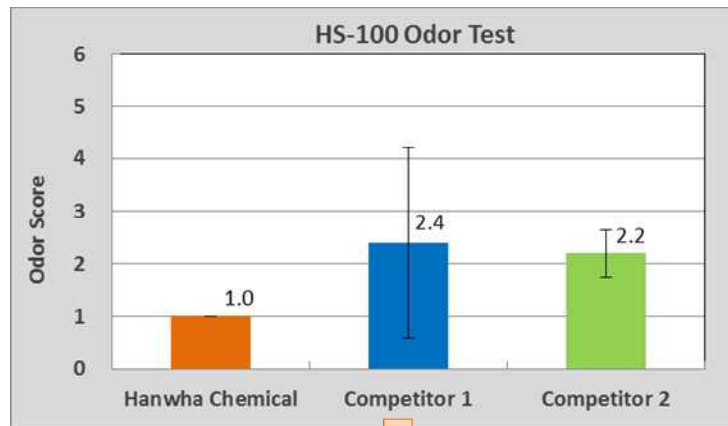
Labeling SIS HMPSA Formulation



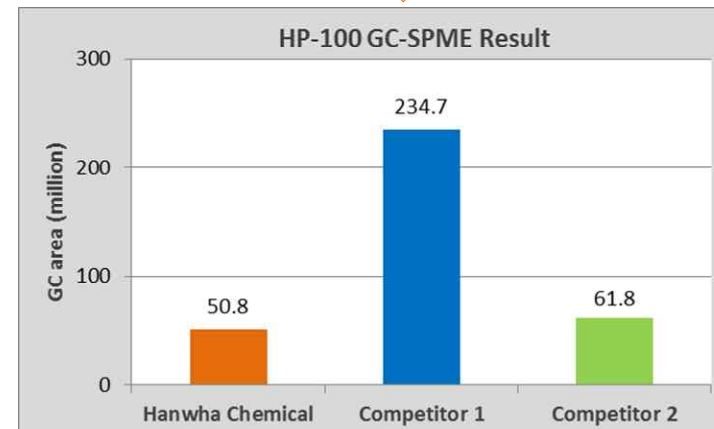
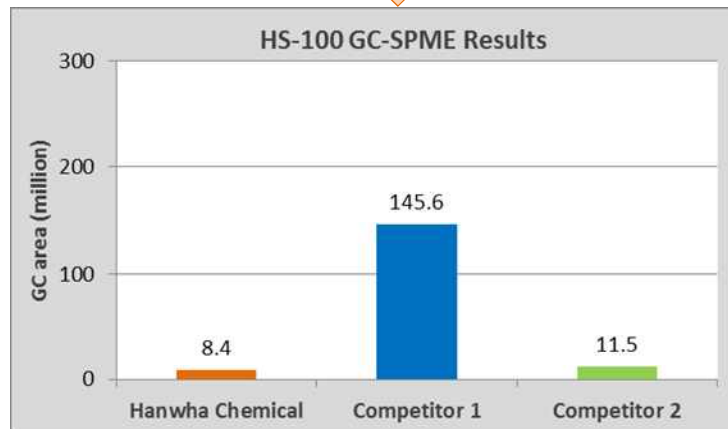
SIS (SM15%, Di-block 18%; 25): Tackifier (57): Wax (18); 180°C, 72hr aging

The Strengths of Our H-HCR: **Low Odor**

Sensory Test



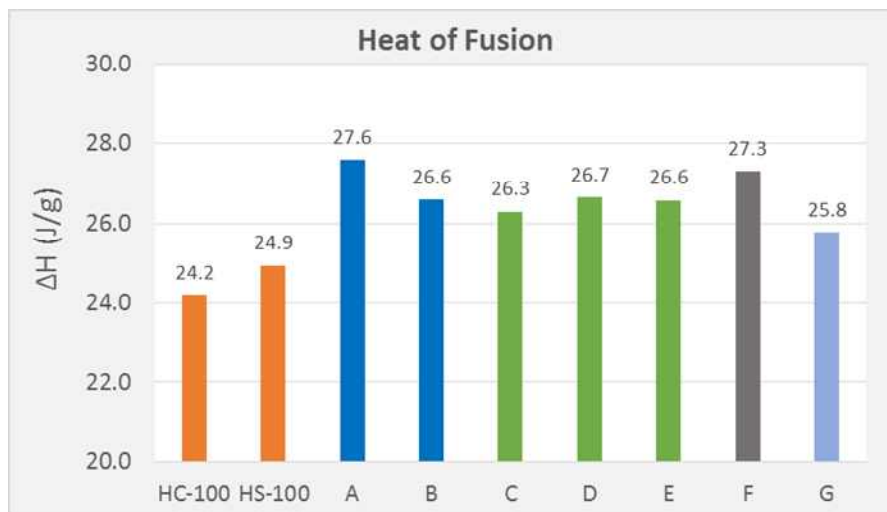
Quantitative Analysis



*Our products show a **good odor quality**. And we developed a **quantitative odor test method**.*




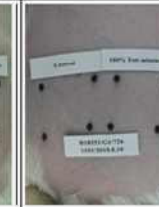
The Strengths of Our H-HCR: Heat of Fusion / Non-Toxic

Lower heat of fusion than competitors



Low heat of fusion makes it possible to save the utility cost.
And quick HMA melting is available in the same heating condition.

Non-toxic hydrocarbon resin

Sample	P.I.I.	Evaluation of Skin Reactions			
		1hr	24hr	48hr	72hr
Hanwha	0	0	0	0	0
Results					

* Acute Skin Irritation/Corrosion Study of Hydrogenated Hydrocarbon resin in New Zealand Shite Rabbits (Study No. B18552, OECD TG 404)

We're doing a various toxical evaluation.
As a result of skin irritation test, we got a *non-irritant* results.

Product Regulatory Information (in progress)

FDA

Regulation list	Title of regulation
21 CFR 175.105	Adhesives
21 CFR 175.125	Pressure sensitive adhesives
21 CFR 176.180	Components of paper and paperboard in contact with dry food
21 CFR 175.300	Resinous and polymeric coatings
21 CFR 175.320	Resinous and polymeric coatings for poly olefin films
21 CFR 176.170	Components of paper and paperboard in contact with aqueous and fatty foods
21 CFR 177.1210	Closures with sealing gaskets for food containers
21 CFR 177.1520	Olefin polymers
21 CFR 177.2600	Rubber articles intended for repeated use
21 CFR 178.3800	Preservatives for wood

EU Food Contact

Regulation list	Title of regulation
EC 1935/2004	Food Contact Materials – Regulation
EU 10/2011	Plastic materials and articles intended to come into contact with food as regards information in the supply chain
94/62/EC	EU Packaging Directive

Toxicological Testing

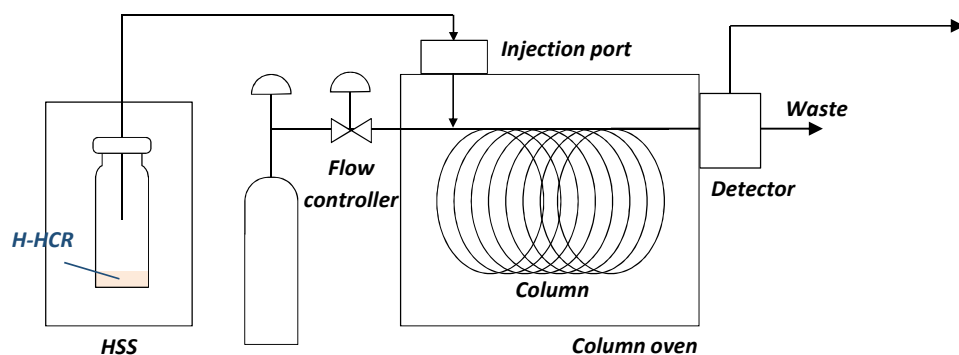
- Acute toxicity
- Skin corrosion/irritation
- Eye irritation
- Skin sensitization



Thank you!

Appendix. Analysis Methods

Quantitative GC analysis



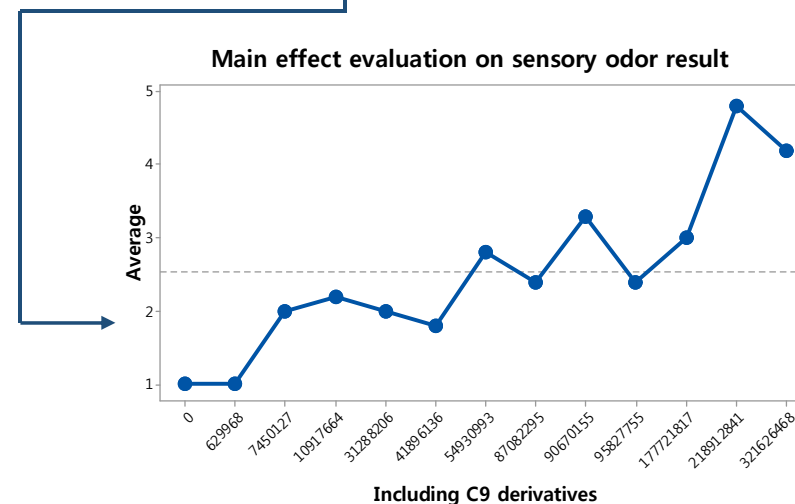
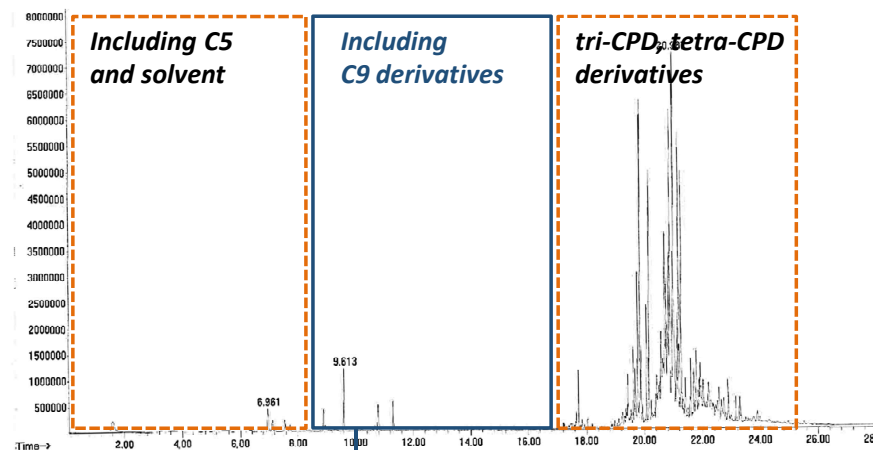
Pre-treatment: 180 °C, 1hr
HSS condition: 80 °C, 0.5hr

There are many kinds of *gas molecules* from the HCR when it is heated up to high temperature.

But, the effect of the gas molecules on odor is depending on their own nature.

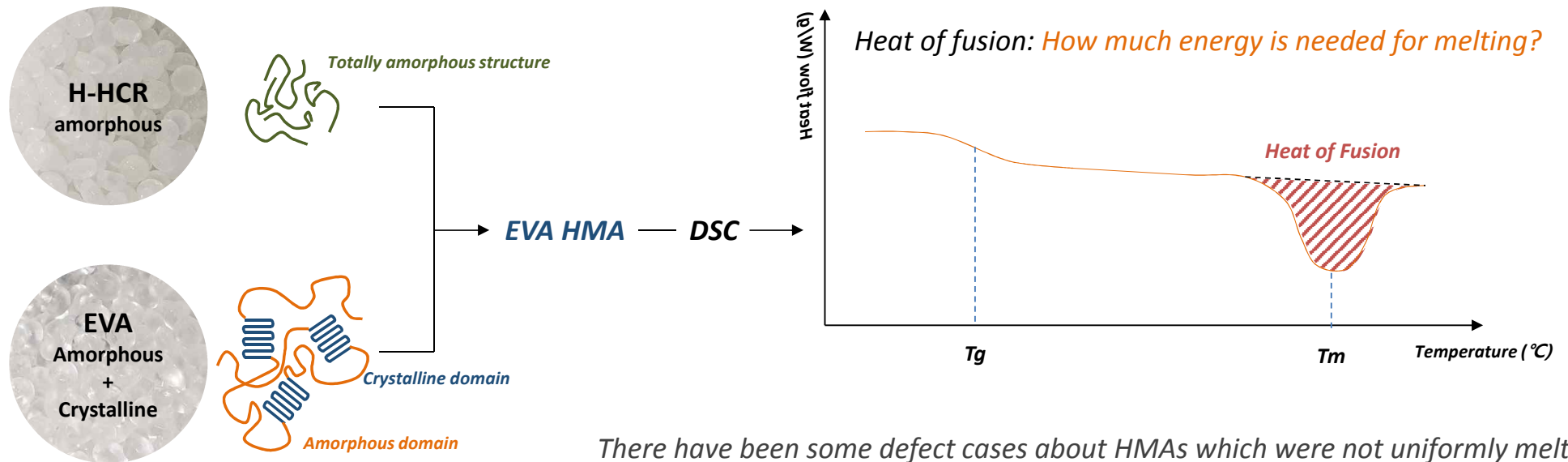
In our experiment, *molecules including C9 derivatives have a main effect on odor.*

A wide range of the analyzed volatile compounds



Appendix. Analysis Methods

Heat of fusion analysis by using DSC



There have been some defect cases about HMAs which were not uniformly melted.

That could have been because of 1) Poor compatibility

2) Broad melting range

3) High heat of fusion

→ **Low heat of fusion** – Be favorable to reduce cost for melting