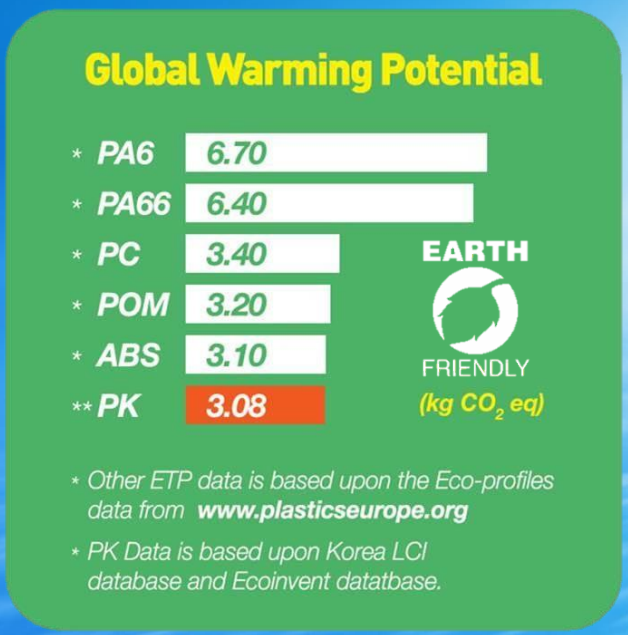
HYOSUNG

POKETONE™
HYOSUNG POLYKETONE

POKETONE™

in cosmetics



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Introduction : POKETONE™
for cosmetics

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POKETONE™
: New choice for cosmetic industry

POKETONE Polymers(PK) are a new class of engineering plastics- semi-crystalline aliphatic polyketone. The resulting molecular chains are linear, perfectly alternating carbon monoxide and alpha olefin structures that possess a unique balance of strength, chemical resistance an barrier properties, making POKETONE Polymers well-suited for a broad range of applications. PK has lowest extractable than other competing materials, and satisfy regulations for cosmetic industry. This Formaldehyde-Free polymer support customers to avoid any risk of safety. Thanks to its chemical resistance and balanced properties, PK can be a reliable choice for cosmetic contact parts.

Safety and Regulations

POM's formaldehyde(FA) issue is well-known. Many players in cosmetic industry are trying to prohibit formaldehyde and/or formaldehyde donors. Also Tetra-hydrofuran(THF) from PBT is potential issue-maker in cosmetics. The extractible study gives the result as below;

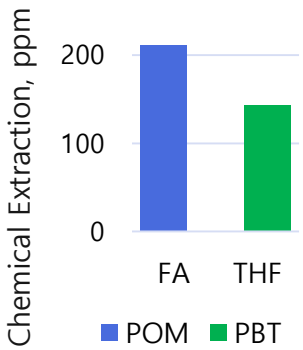

Figure 1. Extractable test at 95°C water for 2 months

The specimen has exposed to 95°C water for 2 months. POM reached 211.3 ppm of FA, and PBT reached 143.9 ppm of THF.

The result of PK gives N.D (Non detectable) for both chemicals.

PK for cosmetics, food contact and medical applications are thoroughly studied and tested for toxicity and other risks. PK satisfies relevant regulations such as;

FDA APPROVED · DVGW · ACS · ISO 10993 · NSF · RoHS COMPLIANT · PAHS · USP Class VI

Chemical Resistance

In addition to good mechanical properties, Engineering Thermo-plastics(ETPs) should have adequate resistance to a variety of chemicals for cosmetics applications.

Moulded POKETONE has a low polarity surface, which coupled with its high crystallinity and close packing in the crystalline phase, indicates potentially good chemical resistance and it has proved to be the case from many studies.

ETPs' chemical resistance in general could be summarized as below table. POKETONE exhibits resistance to a wide variety of reagents. Especially noteworthy is the resistance of POKETONE towards aqueous environments – salts, acids, bases relative to PA66 for example.

Chemicals	PK	PA66	POM	PBT	PPS	PVDF
Hydrocarbons						
Aliphatic	◎	◎	◎	◎	◎	◎
Aromatic	◎	◎	◎	◎	◎	◎
Halogenated	◎	◎	◎		◎	◎
Ketones	◎	◎	◎	◎	◎	
Esters/Ethers	◎	◎	◎	◎	◎	◎
Aldehydes	◎	●	◎	◎	◎	◎
Aqueous						
Water	◎	●	◎	●	◎	◎
Weak Acids	◎	●	●	●	◎	◎
Weak Bases	◎	●	◎	●	◎	●
Strong Acids	●	●	●	●	●	◎
Strong Bases	●	●	◎	●	●	●

◎ : Resistant ● : Not Resistant

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Chemical Exposure Test

Polyketone Polymers(PK) compete with Polyoxymethylene(POM) and Polybutylene terephthalate(PBT) for cosmetic application. As development of PK have progressed over the period, questions concerning PK's actual performance in chemicals used in cosmetic industry have emerged. To address some of these questions, chemical exposure testing was conducted in the laboratory using injection moulded specimens.

Following chemicals have been used;

Water / Boiling Water

IDD (Isododecane : Branched chain aliphatic hydrocarbon. IDD is used as emollient and solvent in skin care products)

Vaseline

The results of the test confirm that PK exhibits resistance to the chemicals as well as POM and PBT.

Results and Discussion

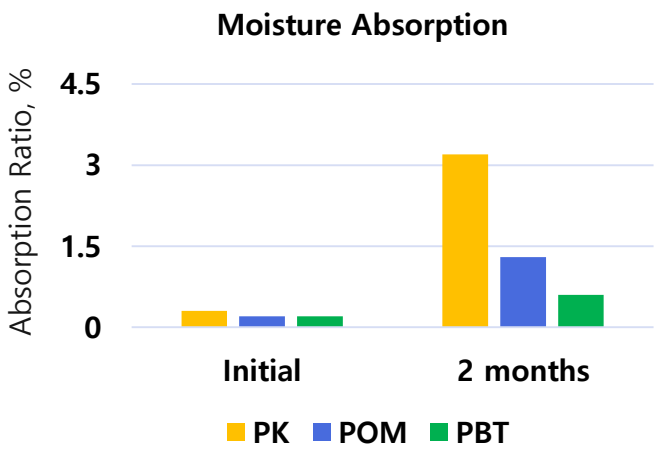

Figure 1. Moisture absorption ratio at 55°C Water

Figure 1 shows PK uptakes relatively more moisture than POM and PBT. However, PK has a better hydrolytic stability than condensation polymers, PBT and POM. Figure 2 shows the mechanical property change of PK, POM and PBT when they are aged in harsh hydrolytic condition(boiling water).

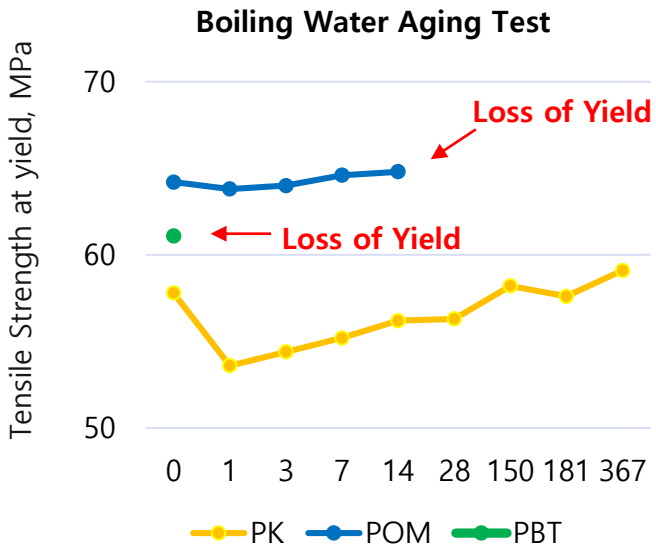

Figure 2. Effect of aging in boiling water on tensile strength at yield of PK, POM and PBT

PK shows no significant variations on the strength at yield. After initial drop by moisture absorption, a level of initial value is maintained during the whole aging period. However, the condensation polymers, PBT and POM, are very sensitive. PBT does not yield anymore already, after one day exposure to boiling water. POM keeps its property up to 14 days exposure. After 28 days, POM has a brittle failure behavior.

The weight change recorded against tested chemicals is recorded as below, Figure 3. PK, POM and PBT lose the weight in IDD and Vaseline. And the rank is PK > PBT > POM.

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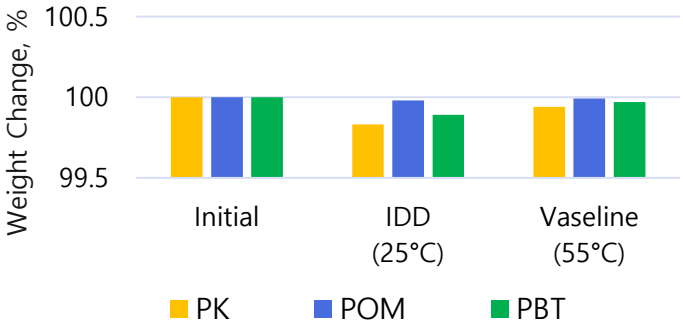

Figure 3. Weight change after 2 months against each chemical with temperature

Figure 4 shows that all three polymers loss tensile strength in aqueous substances, but the property is increased in IDD, PDMS and Vaseline. The amount of change is big in the order of PK > PBT > POM.

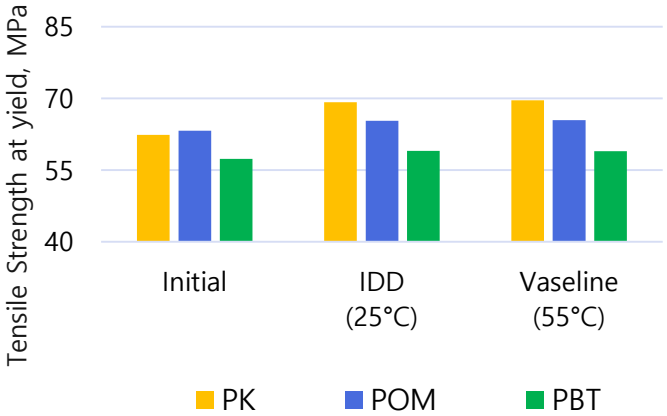

Figure 4. Effect on Tensile strength at yield with 2 months exposure of chemicals

In the mild condition of chemicals, it is not easy to say which one is superior over other competing materials. However, PK has an advantage over others in harsh conditions such as boiling water.

Case Study : Dispensing Pumps

Airless pump in cosmetics is one possibility for PK. Hyosung Chemical Corporation is cooperating with leading global companies to develop PK for the application. We produce PK parts using existing mould for POM, and have done operational test to check the possibility of replacement of POM to PK. As a result, PK is possible to replace POM for airless pump system.

The operational sequence of the pump is 'cylinder moving → (Friction force between Seal cap and Cylinder) → Seal cap open → (Friction force between Seal cap and housing) → Seal cap moving' as below figure 2.

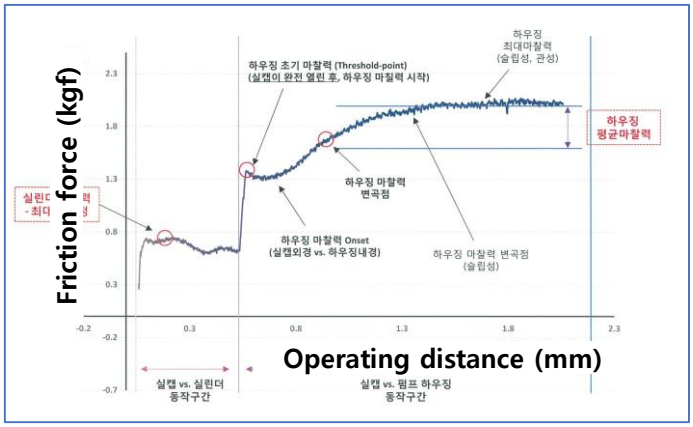

Figure 2. Operational mechanism for airless pump

We have examined frictional force of POM and PK pumping system. As we see in Figure 3, PK system gives similar results with POM for 10 times of test.

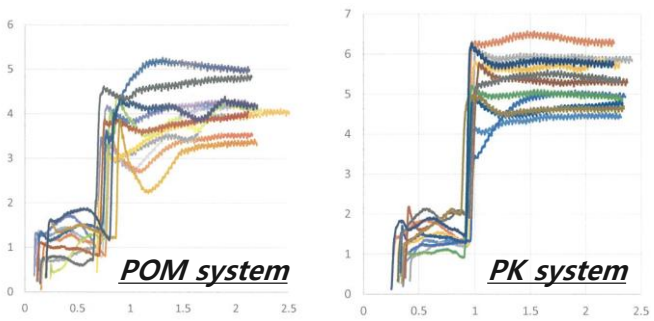

Figure 3. Operational test for POM and PK pumping system

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