

Technical Information

**Low Friction/Flammability Modifier
for Engineering Plastics(PC)**

METABLEN SX-005

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1. Effect of METABLEN SX-005 as Low Friction Modifier

I. EVALUATIONS

1. Sliding Wear Resistance
2. Izod Impact Strength (23°C、-30°C)
3. Melt Flow Rate

II. FORMULATION

PC(MITSUBISHI Engineering-Plastics NOVAREX 7022A)	100.0(phr)
METABLEN SX-005	0 - 20
PTFE (powder)	10

Pellet Extrusion

Extruded with 30 mm diameter twin-screws.

Revolution: 150 r.p.m.

L/D : 24

Designated Temperature (°C) Die : 240°C

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1-1. Sliding Wear Resistance (The thrust ring style)

1) Experimental Conditions

Injection Molding (Thrust ring)

Molded with 50t injection machine

Designated Temperature (°C) Die : 280

Metal Mold : 80

Method (MRC Method)

1. measurement of Critical PV

Load: 0.1MPa (1.0Kgf/cm²)

Speed: 20cm/sec.

2. Sliding Wear Resistance

Load: 0.1MPa (1.0Kgf/cm²)

Speed: 15cm/sec.

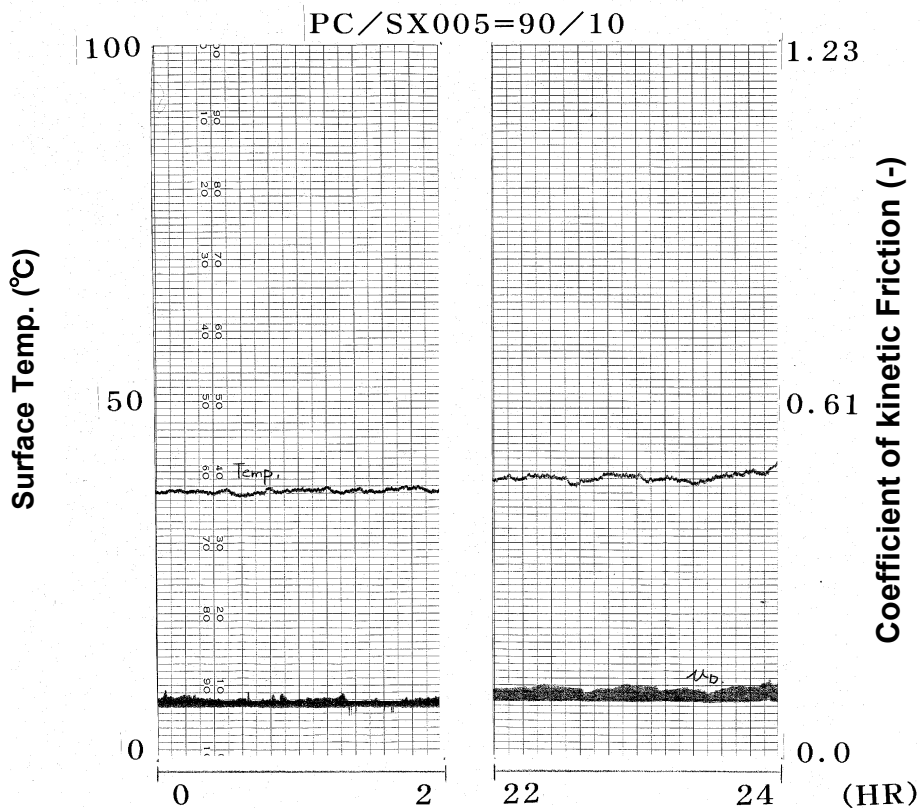
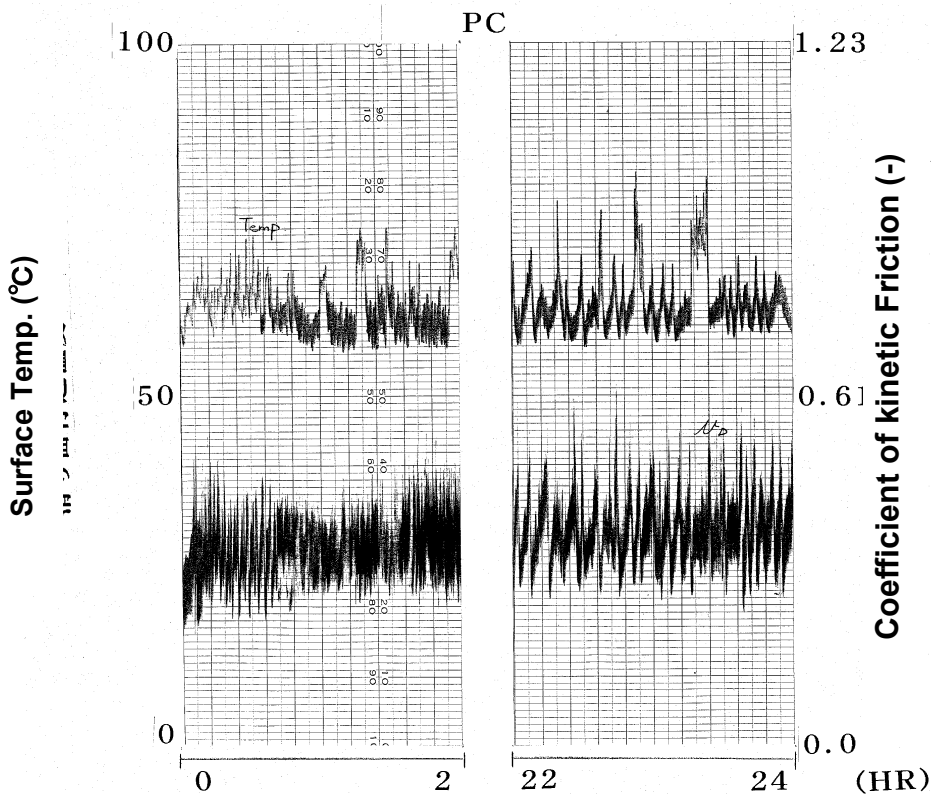
Time : 24 hr

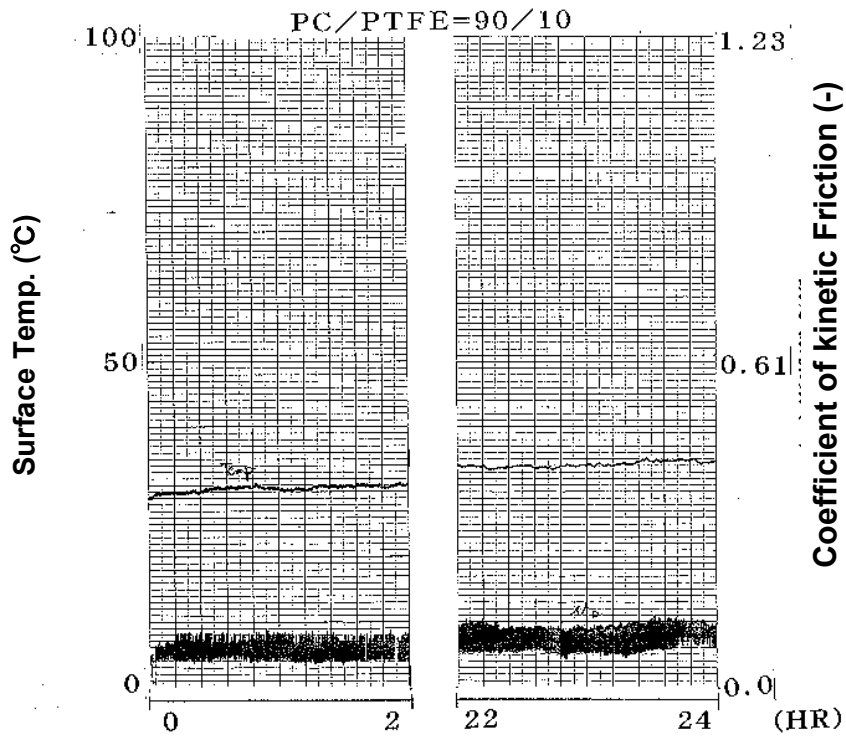
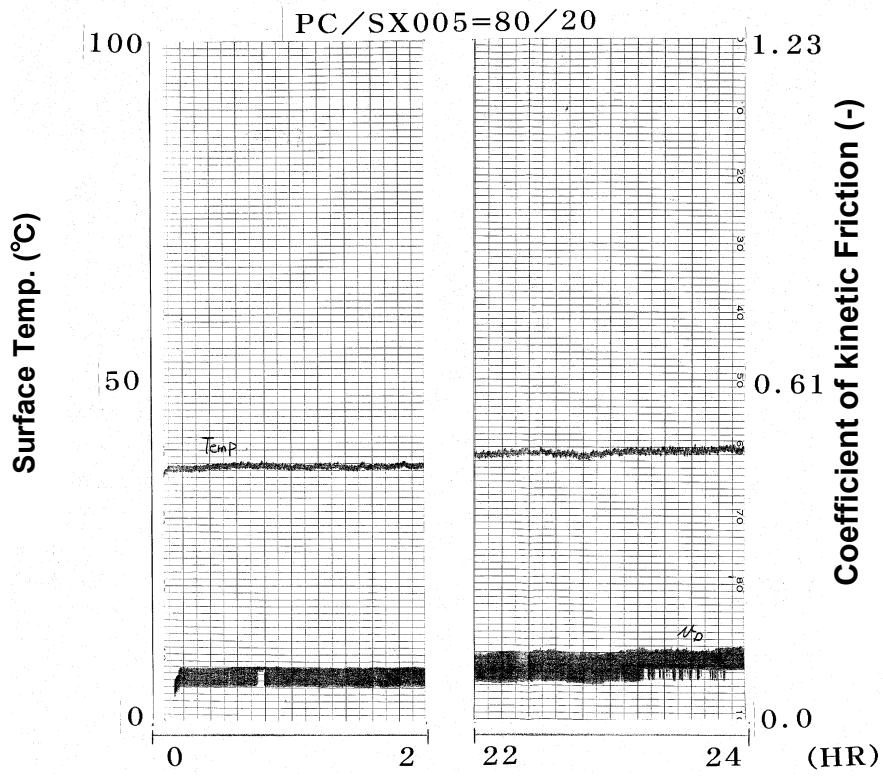
2) Results of Experiments

Table-1 Sliding Wear Resistance(See the Test Chart)

Sample	Ratio	Abrasion loss ($\times 10^{-3}$ mm ³ /N·m)			Coefficient of kinetic friction(-)		Surface temp.(°C)
		Fixed side	Spin side	Total	(0~2hr)	(20~24hr)	
SX-005	100/ 0	7.41	9.89	17.30	0.53	0.76	70
SX-005	95/5	0.01	0.01	0.02	0.22	0.25	39
SX-005	90/1 0	0.01	0.01	0.02	0.17	0.23	39
SX-005	80/2 0	0.05	0.04	0.09	0.15	0.20	39
PTFE	90/1 0	0.00	0.01	0.01	0.14	0.18	31

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1-2. Izod Impact Strength**1) Experimental Condition****Injection Molding**

Molded with 75t injection machine

Designated Temperature (°C) Die : 250

Metal Mold : 60

Method (JIS K-7110)

1/8" mold notch

Temp. : 23°C、-30°C

2) Results of Experiments

Table-2 Izod Impact Strength

Sample	Ratio	Izod Impact Strength (KJ/m ²)	
		23°C	-30°C
SX-005	100/0	92	13
SX-005	95/5	68	40
SX-005	90/10	62	46
SX-005	80/20	47	39
PTFE	90/10	16	12

1-3. Melt Flow Rate**1) Experimental Condition****Method (JIS K-7210)**

Temp. 220°C, Weight: 21.6N

2) Results of Experiments

Table-3 Melt Flow Rate

Sample	Ratio	MI (g/10min)
SX-005	100/0	2.34
SX-005	95/5	2.16
SX-005	90/10	1.89
SX-005	80/20	1.49
PTFE	90/10	1.98

2. Effect of METABLEN SX-005 as Flame-retardant

I. EVALUATIONS

1. Flammability
2. Spiral Flow
3. Sliding Wear Resistance
4. Izod Impact Strength (23°C、-30°C) and Flexural Modulus
5. HDT

II. FORMULATION

PC(MITSUBISHI Engineering-Plastics NOVAREX 7022A)	100.0	(phr)
METABLEN SX-005	0 - 20	
Flame-retardant (TPP)	0 - 15	
Phenol Stabilizer	0.5	
PTFE	0 or 0.5	

Pellet Extrusion

Extruded with 30 mm diameter twin-screws.

Revolution: 150 r.p.m.

L/D : 24

Designated Temperature (°C) Die : 240°C

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2-1. Flammability

1) Experimental Condition

Injection Molding

Molded with 75t injection machine

Designated Temperature (°C) Die : 260

Metal Mold : 80

Method (UL-94(VB))

Size: 1.27 × 12.7cm

Thickness: 1/8” , 1/16”

2) Results of Experiments

Table-4 Flammability (1)

	phr	phr	phr	phr
PC	100	95	90	80
METABLEN SX-005	0	5	10	20
Stabilizer	0.5	0.5	0.5	0.5
UL-94 1/16”	V-2	V-2	V-2	Fail
Total Burning Time(sec.)	209	106	76	-
UL-94 1/8”	V-2	V-1	V-0	V-1
Total Burning Time(sec.)	148	73	29	81

Table-5 Flammability (2)

	phr	phr	phr	phr	phr
PC	80	100	90	80	80
METABLEN SX-005	20	0	10	20	20
TPP	15	7	7	7	7
PTFE	-	-	-	-	0.5
Stabilizer	0.5	0.5	0.5	0.5	0.5
UL-94 1/16”	V-0	V-2	V-0	V-0	V-0
Total Burning Time(sec.)	7	59	27	32	24

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2-2.Spiral Flow**1)Experimental Condition****Injection Molding**

Molded with 75t injection machine

Designated Temperature (°C) Die : 260 , 300

Metal Mold : 80

Method (MRC Method)

Thickness : 1mm

2) Results of Experiments

Table-6 Spiral Flow

CT(°C)	260			300		
	phr	phr	phr	phr	phr	phr
PC	100	90	80	100	90	80
METABLEN SX-005	0	10	20	0	10	20
TPP	7	7	7	7	7	7
Stabilizer	0.5	0.5	0.5	0.5	0.5	0.5
Spiral Flow (mm)	227	248	260	347	398	418

2-3. Sliding Wear Resistance (The thrust ring style)

1) Experimental Condition

Injection Molding (Thrust ring)

Molded with 75t injection machine

Designated Temperature (°C) Die : 260

Metal Mold : 80

Method

Method (See attached sheet)

1. measurement of Critical PV

Load: 0.1 MPa (1.0Kgf/cm²)

Speed: 20cm/sec.

2. Sliding Wear Resistance of fixed PV.

Load: 0.1 MPa (1.0Kgf/cm²)

Speed: 15cm/sec.

Time :24 hr

2) Results of Experiments

Table-7 Sliding Wear Resistance

	phr	phr	phr
PC	100	90	80
METABLEN SX-005	0	10	20
TPP	7	7	7
Stabilizer	0.5	0.5	0.5
Coefficient of kinetic friction 0~2hr (-)	0.5	0.1	0.1
Coefficient of kinetic friction 22~24hr (-)	0.5	0.1	0.1
Surface Temperature 0~2hr (°C)	67	40	37
Surface Temperature 22~24hr(°C)	68	42	38
Abrasion Loss ($\times 10^{-4}$ mm ³ /N·m)	62.1	0.4	0.3

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2-4. Izod Impact Strength and Flexural Modulus**1) Experimental Condition****Injection Molding**

Molded with 75t injection machine

Designated Temperature (°C) Die : 260

Metal Mold : 80

Method

a) Izod Impact Strength (JIS K-7110)

1/8" mold notch

Temp. : 23°C、-30°C

b) bending Test (JIS K-7203)

Span Length: 50mm

Speed: 1.5mm/min

2) Results of Experiments**Table-8 Izod Impact Strength and Flexural Modulus**

	phr	phr	phr
PC	100	90	80
METABLEN SX-005	0	10	20
TPP	7	7	7
Stabilizer	0.5	0.5	0.5
Izod Impact Strength/ 23°C(KJ/m ²)	6.3	63.5	48.3
Izod Impact Strength /-30°C (KJ/m ²)	5.9	45.9	35.5
Flexural Modulus (GPa)	2.60	2.22	1.80

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2-5. HDT**1)Experimental Condition****Injection Molding**

Molded with 75t injection machine

Designated Temperature (°C) Die : 260

Metal Mold : 80

Method (JIS K-7207)

Weight:182N (18.6Kgf)

2) Results of Experiments

Table-9 HDT(1)

	phr	phr	phr	phr
PC	100	95	90	80
METABLEN SX-005	0	5	10	20
Stabilizer	0.5	0.5	0.5	0.5
HDT	128	127	127	125

Table-10 HDT(2)

	phr	phr	phr	phr	phr
PC	80	100	90	80	80
METABLEN SX-005	20	0	10	20	20
TPP	15	7	7	7	7
PTFE	-	-	-	-	0.5
Stabilizer	0.5	0.5	0.5	0.5	0.5
HDT	70	98	95	92	92

別紙 スラスト摩擦摩耗試験方法

1) 限界PV値の決定

a) 限界PV値とは

摩擦熱による単位面積表面の温度上昇は、動摩擦係数を一定とするとP(荷重)とV(速度)の積に比例する。

限界PV値とは摩擦熱に由来する使用限界を表した数値であり、摩擦熱により表面溶融や摩擦係数摩耗が急激に増加するPとVの積である。

b) 評価方法

荷重または速度の一方を段階的に増加させ、接触面付近温度が急激に上昇したPとVの積を測定する。

2) 一定PV値による動摩擦係数、比摩耗量の測定

a) 一定PV値の決定

一定PV値=限界PV値 - 5

b) 評価方法

一定PV値にて24時間運転したときの摩擦力および摩耗量から、それぞれ動摩擦係数と比摩耗量を計算し求める。

動摩擦係数

・軸中心0点のモーメント $F \times R = f \times r$

・動摩擦係数 μ $\mu = \text{摩擦力}(F) / \text{荷重}(L)$ であるから

$$\mu = f \times r / L \times R$$

- F : 試料中心半径の摩擦力
- f : ロットセルで検出した摩擦力
- R : 試料平均半径
- r : 軸中心ロットセル長さ
- L : 荷重

比摩耗量

比摩耗量は摩耗量(W)が滑り距離(D)および荷重(L)に比例すると仮定した比例定数。

単位距離、単位荷重当りの摩耗量を体積で示す。

$$\kappa = W / D \cdot L \text{ (mm}^3 / \text{N} \cdot \text{m)}$$