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TEDA & TOYOCAT NEWS

Tosoh Corporation

Head Office
Tosoh Corporation
Fine Chemicals Division
1-7-7, Akasaka, Minato-ku
Tokyo, Japan
Phone :(81)-3-3585-9891
Telefax :(81)-3-3588-8120
Person : M. Kudo, Y.Hamanaka

Europe Office
Tosoh Europe B.V.
Crown Building - South,
Hullenbergweg 359, 1101 CP
Amsterdam Z.O., The Netherlands
Phone :(31)-20-691-8104
Telefax :(31)-20-691-5458
Person : Peter Bregman

U.S.A. Office
Tosoh USA, Inc.
Suite 600, 1100 Circle 75 Parkway,
Atlanta, Georgia 30339-3097
U.S.A.
Phone :(1)-770-956-1100
Telefax :(1)-770-956-7368
Person : Donald W. Lowe

It is a great pleasure to present our sixth issue of the TEDA & TOYOCAT News. We hope it will assist you to obtain maximum benefit from our products. We would be glad to supplement this information at some mutually convenient time. In the meantime, please do not hesitate to call upon us if there is some other way in which we can be of assistance.

TOPICS

TOSOH PRESENTS A NEW CATALYST SYSTEM "TOYOCAT-S10" AT U'TECH Asia '97.

At U'TECH Asia '97 held on February 18-20 in Singapore, TOSOH introduced information on a new amine catalyst. Our presentation title was "Tertiary Amine Catalyst Systems for Shoe Sole Polyurethane Foam".

TOSOH Corporation has examined the effectiveness of various tertiary amine catalysts associated to the fast cure with expanded cream time. We evaluated many delayed action catalysts, and we found that acid can't make cream time delay unexpectedly. Because the premix temperature of shoe sole system is high, blocked acid was released and not effective for long cream time. Thermosensitive catalysts are effective for long cream time, but they have to use carefully because their cure speed are poor.

We proposed developments for novel catalyst systems which used TOYOCAT-S10. This catalyst system improves cure speed and flowability simultaneously. Although TEDA-L33E is a good catalyst and has been used well for shoe sole system, but it has a defect " worse flowability". As shown in Table 1, TOYOCAT-S10 can improve the cure speed with identical cream time. It also improves the foam flowability compared with TEDA-L33E. Figure 1 shows the flowability data of each amine catalyst systems. TOYOCAT-S10 can produced better foam properties such as tensile strength, elongation, tear strength and so on. Table 2 shows the foam properties of each amine catalyst systems. TOYOCAT-S10 brings you high productivity and good property foam.

Table 1. Reaction profiles of catalyst systems

Catalyst	L33E	L33E/NP	L33E/MR	S10	L33E/D60
(pbw)	1.2	0.5/0.5	0.45/0.45	0.92	0.60/0.60
Free rise foam*					
Reaction profiles (sec)					
Cream time	10	11	11	10	10
Tack-free time	41	56	55	53	53
Core density (kg/m³)	218	189	185	185	202
Mold foam**					
Overall Density(kg/m³)	512	494	500	503	525
Hardness (shore-C)	67	58	60	63	64
Bending time (min)	6.0	6.5	6.0	5.5	7.0
Moldability***	4	2	3	2	4
Skin****	1	3	2	2	2

* Free rise foam, 500ml polyethylene cup
**Mold=300x150x6mm
***Moldability ; 1=good 3=medium 5=inferior
****Skin ; 1=good 3=medium 5=inferior

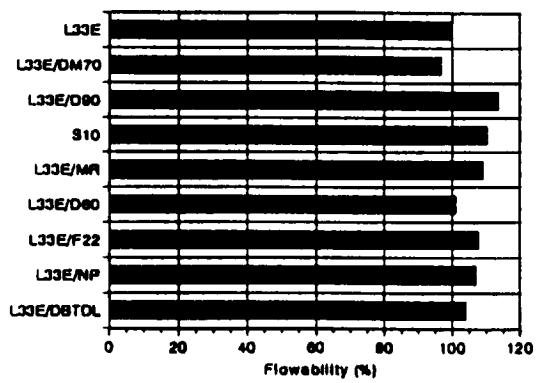

Fig 1. Flowability of Amine Catalyst System

Table.2 Foam properties

Catalyst	Density kg/m³	Dimensional Stability(%)	M_{100} Kg/cm²	M_{300} Kg/cm²	T_B Kg/cm²	E_B %	Tr Kg/cm	Flowability %
L33E	495	99.3	13.6	24.9	31.1	398	23.4	100
S10	507	99.4	15.2	28.3	38.8	427	25.7	110.1
L33E/D60	496	99.4	15.4	26.4	34.8	432	25.0	100.9
L33E/D90	505	99.4	14.5	26.9	35.9	418	25.3	113.6
L33E/F22	476	99.2	13.3	24.7	29.7	388	22.3	107.7
L33E/DM70	513	99.4	15.9	29.0	39.2	425	26.6	96.6
L33E/NP	492	99.5	14.2	26.2	32.3	365	23.0	106.8
L33E/DBTDL	515	99.3	16.3	30.7	45.3	438	26.2	103.8

T_B : Tensile strength at break
E_B : Elongation at break
Tr : Tear strength at break

INFORMATION

What is the next blowing agent!? (HFC-245fa?)

In conformity with the Montreal Protocol which was ratified in 1987 and readjusted some time, CFC-11 can't be used anymore in most country.

HCFC-141b was developed as the alternative blowing agent and has been the predominant blowing agent. But it is said that HCFC-141b has no long life and it will be phased out by the end of 2004 due to its depletion of the ozone layer. New alternative blowing agent has to be developed especially for rigid PU foam. Many research has been worked and "International Conference on Ozone Protection Technologies" was held at Washington,D.C. on last October. Even now next agent has not been decided yet, some promising candidates were announced. In Japan, seven major refrigerator manufactures joined the project subsidized by MITI and they think that HFC-245fa or 236ea could be useful as a next generation blowing agent. As shown in Table 3, the boiling point of HFC-245fa is lower than that of CFC-11 or HCFC-141b. So the foam using HFC-245fa will blow as froth state. But Araki et al[*1] said that the current foaming equipment for refrigerators might be also applicable to the agent without substantial modifications, for mass production of refrigerator. Suzuki et al[*2] said that the thermal conductivities at lower temperature of the polyurethane foam blown by HFC-245fa are comparable to that by HCFC-141b (Figure 2 and Table 4). He also mentioned that the important temperature for refrigerator was around 4 degree centigrade, so HFC-245fa would be useful as blowing agent. Allied Signal is promoting HFC-245fa strongly and they announced that they would cooperate with Asahi Glass Co., Ltd in Japan.

Preliminary toxicity study of HFC-245fa did not show any significant adverse effect so far. But it needs more time to check additional safety test, so it will be sold after one year or more.

(1) K.Araki et. al., International conference on ozone protection technologies (1996) p.477
(2) M. Suzuki et. al., International conference on ozone protection technologies (1996) p.487

Table 3. Physical properties of blowing agents

blowing agent	boilng point °C	thermal conductivity kcal/mhr °C
CFC-11	24	0.0140
HCFC-141b	32	0.0151
HFC-245fa	15.3	0.0169
HFC-236ea	6.5	0.0173
c-pentane	49.5	0.0171

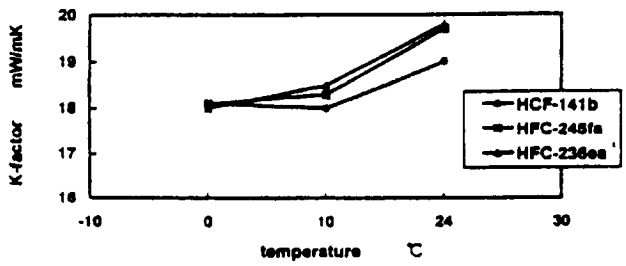

Fig.2 Relationship between thermal conductivity and temperature (Measured by Eikoseiki HC-073)[(2)]

Table 4. Properties of high pressure machine made foam (test mold)(2)

Property		HCFC-141b	HFC-245fa	HFC-246ea
Free-blow foaming				
Cream time	(sec)	7-8	froth	froth
Gel time	(sec)	38-40	30	39
Tack free time	(sec)	41-42	35	42
Core foam density	(kg/m^3)	25.4-25.5	28.3	29.9
Panel foaming				
Overall density	(kg/m^3)	38.0-38.1	34.7	39.8
Core density	(kg/m^3)	30.9-31.2	29.5	36.0
K-factor* 24°C	(kcal/mh°C)	0.0127-0.0130	0.0133	0.0136
	(mW/mK)	14.8-15.2	15.5	15.9
Compressive strength				
	(kg/cm^2)	1.05-1.06	1.21	1.48
Dimensional stability				
-20°C× 24h	(%)	-0.7 - -0.8	-0.5	-0.7
70°C× 24h	(%)	0.8 - 1.2	1.0	0.6
Cell size	(μm)	200-220	210-240	210-240

TECHNICAL VIEW

NEW CATALYSTS "TOYOCAT-W25" FOR FLEXIBLE SLAB FOAM.

TOSOH is always developing improved catalyst system for all applications, and has just developed a new catalyst "TOYOCAT-W25" for flexible slab foam.

For this application, TEDA is well used and it has brought you good results. But recently, good foam properties like better air flow are requested. TOSOH has been investigated for this matter and just developed a new catalyst system "W25". The data which was applied for methylenechloride blown system are shown in Table 5. As shown in Table 5, TOYOCAT-W25 improves air flow, tensile strength, tear strength. Using the blowing catalyst like ET to get good air flow, it causes the cream time too fast, and other foam properties (elongation, tensile strength) becomes worse.

Table 5. Reaction times and physical properties

Catalysts	L33	W25	L33/ET
pbw	0.2	0.2	0.2/0.1
Reaction time			
Cream time(sec)	18	15	12
Tack free time(sec)	98	111	85
Foam properties			
Core Density (kg/m^3)	17.2	17.1	16.8
Air flow (ft^3/min)	*1.35*	*1.75*	*1.75*
Elongation(%)	118	116	107
Tensile strength (kgf/cm^2)	0.55	0.68	0.51
Tear strength (kgf/cm)	0.46	*0.81*	0.72
CLD25% ($kgf/314cm^2$)	8.6	9.6	9.3
CLD65% ($kgf/314cm^2$)	15.8	17.1	16.6
Dry SET (%)	-3.2	-4.4	-4.0

TEDA & TOYOCAT® APPLICATION GUIDE

GENERAL		
Gelling Catalyst (L33)	Long Cream Time	TF
Blowing Catalyst (ET)	Long Cream Time	ETF
	Cost Saving	DT
FLEXIBLE FOAM		
Slabstock	Fast Cure	M50/ET
	Odorless	L33/D60
	High Air Flow	W25
Hot Cure	CFC-free (high air-flow, low density)	L33/F10
TDI Based HR (TDI/MDI)	Moldability (long cream time)	SPF2, B41/DT
	Moldability (at low mold temp.)	M50, L33/D60/ET
	Odorless, Fast Cure, Moldability	L33/D60/ET
	Anti-fogging	HX63
	Low Density, Moldability	L33/ET/F10
all-MDI based HR	Odorless, Fast Cure, Moldability	L33/D60/ET
	Moldability, Fast Cure	SPF2, M50
	Low Density, Moldability	L33/ET/F10
SEMI-RIGID FOAM/OTHERS		
Headrest, Armrest	Moldability, Substitute for TEA	M50
Instrument Panel	Anti-Vinyl Stain, Moldability	HX63/ET, HX70/ET
Composite Panel	Flowability, Fast Cure	TF, B41
Packaging	Anti-Fogging	RX5, HX75
ISF(CFC-free)	Skin Formation	F22/L33, F22/M50
	Flowability, Fast Cure, Moldability	F10/ETF, L33/ETF
RIGID FOAM		
Cyclopentane Blown	Dimensional Stability, k-factor	NP
	Flowability, Dimen. Stability, k-factor	NP(or MR, DMCH)/TMF
HCFC-141b Blown	Flowability, Dimen. Stability, k-factor	NP(or MR, DMCH)/TMF
	Low Expansion at Demold (Fast Cure)	DMCH/F40
Water Blown	Friability	DM70
	Dimensional Stability	MR(or DMCH, TE)/DT
Sprayed Foam	Optimized Package	B2, B71
	Improve Adhesive Strength	B2(or B71)/DM70
Isocyanurate Foam	Smooth Profile	TRC(or DT)/K-Octoate
ELASTOMER		
Shoe Sole	Fast Cure	S10, L33E/S10
	Low Density(CFC-free), Flowability	S10, L33E/S10
Elastomer	Delayed action, Flowability, Fast Cure	L33/TF, L33/F22
	Long Pot Life	F22