The Chairman's Greetings

DONGJIN SEMICHEM promises to always be with our customers as a trustworthy partner.

Since our establishment in 1967, DONGJIN SEMICHEM has been growing as a pioneer in the domestic and international fine chemistry field.
Through our continuous remarkable scientific and technical progress, we are now able to contribute to society in a wide range of fields, from foaming agents to chemicals for electronic (semiconductors, displays, new energy) materials.
Our priority is to become a corporation that earns the trust of its customers, which means that we make every efforts to provide the best quality products.

I would like to sincerely thank you for your interest and support.

Currently, we are leveraging our ample experience and accumulated technologies to reach a turning point in our development of our company.

Through the development of high technologies and the cultivaion of world-class talents, we are preparing to step forward as a global fine chemical enterprise, as well as a company that can make our society a place of happiness and pleasure.
We promise to serve as your trusted partner and provide you with high-quality products that can meet the needs of the 21st century, where high scientific technologies will be dominant.

Thank you

Boo Sup Lee, Chairman & CEO
DONGJIN SEMICHEM CO., LTD.

UNICELL

UNICELL is the brand name of Dongjin Semichem Co., Ltd. Product UNICELL stands for the most excellent quality foaming agents and activators in plastics and rubber industry.

There are 2 type products in UNICELL - Foaming agent (Chemical / Physical) and Activators.

Foaming Agents

Chemical Foaming Agents : Make the cellular structures in plastics and rubbers with evolved gases from the decomposition of foaming agent.
It's also devided into Organic and Inorganic foaming agents.
Most of foaming agents are included into this category.
UNICELL -D / AD / OH / H / BSH / G / TS / C and etc.

Physical Foaming Agents : Make the cellular structures in plastics and rubbers with phase conversion.
UNICELL - MS series

Activators

Organometallic Activators : UNICELL -BM / TM

Modified Urea Activators : UNIPASTE-P2, N

When customers use UNICELL, they will find following advantages;

1. Larger volume and higher yield of evolved gas.
2. Homogeneous dispersion into the Plastics and Rubbers
3. Less contamination
4. Good matching of decomposition with crosslinking speed
5. No adverse effect on the physical and chemical properties of base resins
6. Definite and narrow range of decomposition temperature
7. Easy adjustment of decomposition behaviors
8. Excellent stability and enough shelf-life under the ordinary storage condition
9. Non-toxic, non-objectable odor and relatively harmless to health by following our recommended ways from their MSDS
10. Less influences of residues on the final goods, ie. the residues are colorless, non-staining, non-discoloring and non-flammable

LET'S SELECT THE SUITABLE UNICELL FOR YOUR PRODUCTS!

Master List of UNICELL

Trade Name UNICELL	Chemical Name	Appearance	D.T(℃)[7]	G.V(ml/g)[8]	Applications
D Series	ADCA[1]	Fine yellow powder	202~208	225~250	Plastics and rubbers
NP Series	Modified ADCA	Fine yellow powder	201~204	175~195	Plastics
DK Series	Modified ADCA	Fine yellow powder	160~168	170~195	EVA, Rubbers
DL31 Series	Modified ADCA	Fine yellow powder	140~145	140~190	PVC
DE3	Modified ADCA	Fine yellow powder	155~159	145~165	Chemically embossed PVC
DX Series	Modified ADCA	Fine yellow powder	150~165	125~185	EVA
DWP Series	Modified ADCA	Fine yellow powder	143~193	155~240	PVC wall paper
AD Series	Modified ADCA	Fine yellow powder	132~138	120~140	LDPE, EVA, Rubbers
OH Series	OBSH[2]	Fine white powder	157~163	120~135	Rubbers, PVC, PE
H Series	TSH[3]	Fine white powder	143~147	100~120	Rubbers
BSH Series	BSH[4]	Fine white powder	142~147	85~115	Rubbers
G Series	DNPT[5]	Fine lemon-yellowish powder	197~208	175~230	Rubbers
TS	PTSS[6]	Fine white powder	228~232	125~135	PVC, HDPE, PP, Nylon etc.
C Series	Inorganic Chemicals	Fine white powder	150~220	110~170	PS, PP, PE, ABS
MT Series	Foaming agent Master batch	Yellow pellet			EVA, SHOES
MS Series	Acrylonitrile copolymer	Fine white powder	N/A	N/A	Adhesive sealant, film, binder, thermoset resins and general resins
UNIPASTE	Urea based compound	Fine white powder	N/A	N/A	Activators for UNICELL-D, G, TS and OH
BM/TM Series	Organometalic compound	Fine white powder	N/A	N/A	Activators for UNICELL-D

(1) ADCA Azodicarbonamide
(2) OBSH p,p'-Oxybis(benzenesulfonyl hydrazide)
(3) TSH P-Toluenesulfonyl hydrazide
(4) BSH Benzenesulfonyl hydrazide
(5) DNPT Dinitrosopentamethylene tetramine
(6) PTSS P-Toluenesulfonyl semicarbazide
(7) D.T. Decomposition temperature
(8) G.V. Gas volume

Selection Guide of UNICELL

Resin \ Process	Press Molding	Extrusion	Injection Molding	Calendering	Plastisol Process	Rotational Molding
Rubber	G, H, BSH, DK, AD	D, OH				
EVA	T, D, DX, AD		D, DX			
TPR	T, D, DX, AD		D, AD, MS			
PP		D, TS, NP, C	D, TS			D, TS
PE	D, AD	D, OH, C, TS	D, OH, TS, MS			D, OH
PS		D, C, TS	D, TS, C			D, TS
ABS		D, TS, C	D, TS, C			D
PVC	D, DK	D, C	D, MS	D, T	D, OH, DWP, T, DL, MS, DX, DE3	
Polyamide	D	TS	TS			
Acetal		D	D			
Modified PPO		TS	D, TS			
Polyacrylic		D, TS	D, TS			
Fluoro Plastics		TS				
Polysulfone		TS	TS			
EPOXY	HMS					
Acryl binder					MS / HMS	

An International Quality Assurance Div.

All members of the Quality Assurance Dept. have wide technical experiences, and are always ready to give assistance and service to customers around the world. If you have any question about foaming agents and their applications, please contact the Quality Assurance Dept. or Export & Import Dept.

Emergency Call : +82-2-6355-6100

Emergency Fax : +82-2-338-3935

E-mail : trade@dongjin.com

UNICELL SERIES

DONGJIN SEMICHEM

UNICELL-D SERIES

UNICELL-NP SERIES

UNICELL-DL & DE3 & DK SERIES

UNICELL-DX & DU SERIES

UNICELL-D1500 SERIES

UNICELL-MT SERIES

UNICELL-AD SERIES

UNICELL-DWP SERIES

UNICELL-OH SERIES

UNICELL-H SERIES

UNICELL-BSH SERIES

UNICELL-G SERIES

UNICELL-TS

UNICELL-C SERIES

UNIPASTE-P2 SERIES

UNICELL-BM/TM

UNICELL-MS SERIES

UNICELL-HMS SERIES

UNIBEAD SERIES

UNICELL-D Series

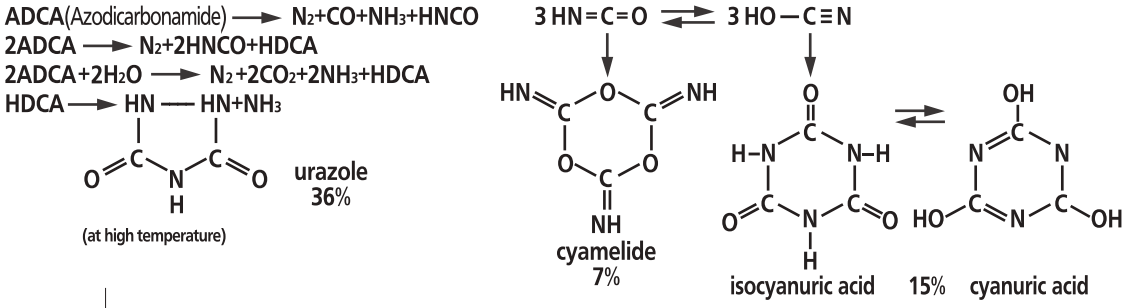
• Azodicarbonamide (Azobisformamide)
• General purpose foaming agents

Description

UNICELL-D series is well known as the most widely used and effective foaming agent for plastics and rubbers, such as PVC, PP, PE, EVA, ABS, PS, EPDM, SBR, NBR and TPR. **UNICELL-D** series can be modified to be suitable to almost all of the rubbers and plastics by additives like activators. **UNICELL-D** series is non-toxic and self-extinguishing material and has relatively high decomposition temperature and evolves a large gas volume. Therefore, it can be used more safely than any other colorless foaming agents and it can produce white, micro-cellular structures.

Decomposition of UNICELL-D series

Decomposition mechanism of **UNICELL-D** series (ADCA) is complex and depends on the heating range and the process condition.



By these reactions, **UNICELL-D** series is decomposed and evolves several kinds of gases as follows.

Table 1. The volume ratio of evolved gases depending on temperature and the ratio of gases & residues after decomposition.

Gas \ Temp		181~198	210~220	250~280
Evolved gas Volume (ml/g)		185~218	263~322	355~454
Residue after decomposition (%)		72.5~76.7	61.3~68.0	46.9~56.5
Gaseous product after decomposition (%)		23.3~27.5	32.0~38.7	43.5~53.1
Evolved Gases	N_2 (%)	70.8~72.9	53.9~58.8	42.6~48.9
	CO (%)	26.0~26.5	32.9~33.1	36.2~40.8
	NH_3 (%)	0~0.9	7.4~12.0	8.2~19.1
	CO_2 (%)	1.0~1.8	0.7~1.2	2.1~2.2

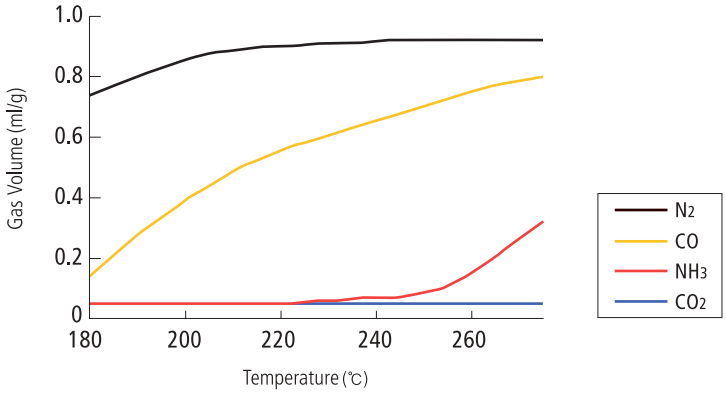


Fig 1. The change of gas components depending on temperature

Properties of UNICELL-D series

Table 2. The physical Properties of **UNICELL-D** series

Item		Specification										
Grade Name		D200A	D300L	D330	D400	D600	D800	D900	D1100	D1300	D1500	D2500
Chemical Name		Azodicarbonamide (Azobisformamide)										
Appearance		Fine Yellow Powder										
Decomposition Temperature (℃)		202~208										
Gas Volume (ml/gr)		225~250										
Average Particle Size (㎛)	Laser	4.8~5.8	5.0~6.0	5.0~5.5	6.2~7.2	8.2~9.0	10.8~11.8	12.0~13.0	14.0~15.0	17.0~19.0	19.0~21.0	27.0~30.0
	Fisher	2.5~2.8	2.6~2.9	2.7~3.0	3.6~3.9	5.7~6.1	7.6~8.0	8.0~8.3	9.6~10.0	12.6~13.0	14.0~17.0	24.0~26.0
Moisture Content (%)		0.3 max.										
Chemical Formula		$H_2N-CO-N=N-CO-NH_2$										
Molecular Weight		116.08										
Specific Gravity (g/㎤ at 25℃)		1.65										
Specific Heat		0.26										
Decomposition heat (kcal/mole)		10										
Solubility (g sample/ 100ml solvent)		in Water 0.020 DMSO 4.300 MEK 0.015 Acetone 0.016 DMF 5.000 Toluene 0.012 Benzene 0.014										
CAS No.		123-77-3										

Particle size of UNICELL-D series

Particle size is a significant factor in determining the speed of decomposition of **UNICELL-D** series.
As the particle diameter decreases, the surface area increases. Thus the heat transfer to the **UNICELL-D** series is more effective and faster, and this influences on decomposition speed of **UNICELL-D** series.
The particle size is selected to provide the proper balance between the curing speed and the decomposition speed of **UNICELL-D** series.

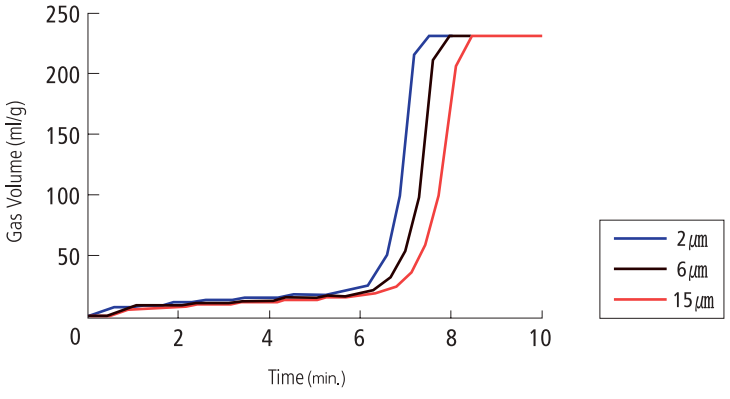
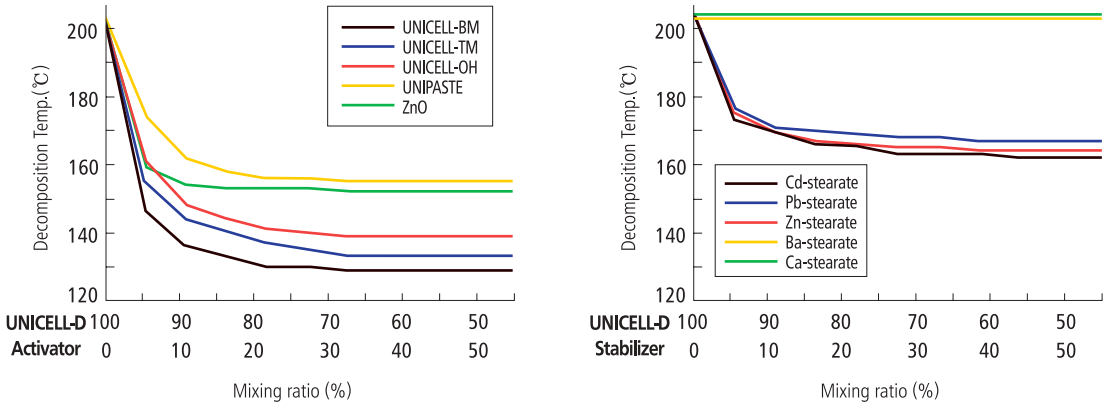


Fig 2. The decomposition behavior of **UNICELL-D** series at the constant temperature of 200℃

Activation (Activator, Kicker)

There are many kinds of activators for **UNICELL-D** series, but they must be selected carefully by several conditions like compatibility, undesirable chemical reaction, etc.
The broad range application of **UNICELL-D** series is due to easy control of decomposition temperature of **UNICELL-D** series with these activators.



(a) UNICELL-D with Activator (b) UNICELL-D with Stabilizer

Fig 3. The decomposition temperature of **UNICELL-D** mixture ; (a) with activators ; (b) with metallic stabilizers

Table 3. The activators for UNICELL-D series and the change of their decomposition temperatures (UNICELL-D : Activator = 1 : 1)

Cadmium Compounds		Strontium naphthenate	153~180	Acetic	140~195
Cadmium oxide	140~184	Strontium zinc laurate	150~180	Citric	145~165
Cadmium perborate	141~165	**Magnesium Compounds**		Succinic	155~190
Cadmium 2-ethylhexoate	115~160	Magnesium oxide	165~200	Salicylic	165~200
Cadmium acetoacetate	157~205	**Lead Compounds**		Acetyl salicylic	165~200
Cadmium dodecylmercaptide	130~180	Lead acetate	127~180	Sulfamic	160~205
Zinc Compounds		Lead oxide	151~180	Loralkyl phosphoric	155~195
Zinc chloride	80~135	Lead sulfate	160~185	Maleic anhydride & water	100~180
Zinc acetate	100~105	Dibasic lead phosphite	145~160	Phosphoric	90~160
Zinc nitrate	105~140	**Tin Compounds**		Butyl phosphoric	130~170
Zinc laurate	150~180	Tin methoxy maleate	140~185	Malic	155~185
Zinc oxide	130~155	Dibutyl tin maleate	150~186	**Bases**	
Zinc octoate	155~190	Stannous oxide	160~210	Guanidine carbonate	135~180
Zinc dust	155~175	**Silicon Compounds**		Potassium carbonate & water	100~145
Zinc carbonate	150~170	Superex clay	140~200	Potassium carbonate anhydrous	155~210
Zinc stearate	150~155	Silene	135~200	Borax	100~185
Zinc propionate	158~185	Superfiltrol	120~165	Ethanolamine	85~100
Barium Compounds		Dixie clay	145~200	**Miscellaneous**	
Barium ricinolcate	145~180	Hi Sil	155~201	Dimethyl formamide	135~160
Barium stearate	162~210	**Acids**		Cupric stearate	145~195
Calcium Compounds		Oxalic	100~150	Aluminium stearate	160~190
Calcium carbonate	155~200	p-Toluene sulfonic	100~180	Titanium oxide	160~195
Calcium stearate	150~175	Glycollic	110~150	Boron trifluoride	120~160
Strontium Compounds		Lactic	115~150		

Material Safety Data

Hazards

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides, Ammonia.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust.
Conditions of storage : Keep only in the original container in a cool, well-ventilated place away from sources of ignition.
Storage with other products : Keep away from food, drink and animal feeding stuffs.

Stability and Reactivity

Conditions to avoid : Keep away from sources of ignition – No smoking.
Dangerous reactions : May occur with strong oxidizing agents, strong acids, strong bases and heavy metal salts.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 5,000 mg/kg
Skin : May cause slight irritation.
Eyes : May cause slight irritation.
Respiratory : May cause allergy or asthma symptoms or breathing difficulties if inhaled.

FDA Compliance

Azodicarbonamide can be used in the following FDA regulated applications.
Section 177.1210, Title21, CFR ; Closure with sealing gasket for food.
container : Azo content limited to less than 2% by weight of closure-sealing composition.
Section 172.806, Title21, CFR ; Azo is allowed for use as an aging ingredient in cereal flour in an amount not to exceed 2.05grs. per hundred pounds of flour and as a dough conditioner in bread baking in a total amount not to exceed 0.0045%.
Section 175.300 and 177.1210, Title21, CFR ; Resinous and polymeric coating (can end cements) 2% by weight allowed.

Other Information

Separate Health and Safety Data Sheets on Azodicarbonamide products are available on request.

UNICELL-NP Series

Description

UNICELL-NP series is non-staining, non-discoloring and odorless nitrogen releasing agent for wide applications into injection molding and extrusion systems.
UNICELL-NP series is recommended in place of azodicarbonamide for applications where problems of steel mold corrosion, die blockage, or screw build up are experienced. Eliminating these problems reduces the time for cleaning operations, and thereby increases the line speed.
UNICELL-NP series is free flowing product that reduces bridging and tunneling encountered in metering and blending equipment, and will be easily dispersed into polymers by simple tumbling with pellets, extrusion or banbury compounding or dispersion as a plastisol.
The decomposition products of **UNICELL-NP** series neither discolor the polymer nor interact with additives to give discolored products.

Properties of UNICELL-NP series

Item	Specification			
Grade Name	D200NP	D300NP	D400NP	D1500NP
Chemical Name	Modified Azodicarbonamide (Azobisformamide)			
Chemical Formula	$H_2N-CO-N=N-CO-NH_2$			
Appearance	Fine Yellow Powder			
Decomposition Temperature (℃)	201~203	201~203	201~203	202~204
Gas Volume (ml/g, at 25℃)	175~195	175~195	175~195	175~195
Moisture Content (%)	4.0 max.			
Application	Injection molding and extrusion of Plastics and Rubbers			

Applications

UNICELL-NP series is recommended for injection molding and extrusion systems. In injection molding, **UNICELL-NP** series can eliminate the mold corrosion or die blockage experienced with pure azodicarbonamide.

UNICELL-DL & DE3 & DK Series

Description

UNICELL-DL series is free of the creamy coloration, normally associated with vinyl expanded with azodicarbonamide. **UNICELL-DE3** can replace azodicarbonamide and zinc based activator where white foams is required. It is an easily dispersible, free-flowing powder which gives good foam structure for plastisol applications. **UNICELL-DK** series releases non-condensable and ammonia-free gaseous products and leaves white residues. The ammonia-free gaseous products introduce fine cellular structures without mold corrosion.

Properties of UNICELL-DL & DE3 & DK series

Item	Specification				
Grade Name	DL31	DL75N	DE3	DK	DK9
Chemical Name	Modified Azodicarbonamide				
Chemical Formula	$H_2N-CO-N=N-CO-NH_2$				
Appearance	Fine Yellow Powder				
Decomposition Temperature (℃)	140~145	142~145	155~159	160~165	163~168
Gas Volume (ml/g, at 25℃)	145~165	170~190	145~165	170~190	175~195
Average Particle Size (㎛)	2.6~3.0	3.5~4.0	2.8~3.2	3.0~3.5	3.0~3.5
Moisture Content (%)	0.3 max.	0.3 max.	0.3 max.	0.5 max.	0.5 max.
Application	PCV Plastisol		PCV plastisol with chemical embossing	Rubber Molding	

Applications

When using **UNICELL-DL & DK** series, processing temperatures may be needed to be lowered to avoid the prematuring decomposition during compounding.
UNICELL-DE3 is commonly used for PVC plastisol chemical embossing and gives increased efficiency, better inhibition and significantly improved whiteness. It may also be used in other plastisol and sponge rubber applications where azodicarbonamide and zinc based activators are used.
When using **UNICELL-DE3**, pre-gelation temperature is better to be lowered to avoid the prematuring decomposition.

UNICELL-DX & DU Series

• Modified Azodicarbonamide (Azobisfomamide)
• Specially designed foaming agents for Natural/Synthetic rubbers, EVA and PVC

Description

UNICELL-DX & DU series has been designed to be used in cellular injection molding, compression molding and PVC extrusion processes.
Each product of the series has unique properties which make them of particular value in the production.
Among these are;
- Plate out solid decomposition residues are eliminated.
- Mold discoloration is eliminated and hence stain free moldings are obtained.
- "Built –in nucleation" gives flexibility during processing.
- Improving physical properties of expanded foam (e.g. tensile strength, elongation, tear strength and compression set etc.

Properties of UNICELL-DX & DU series

Item	Specification				
Grade Name	DX74AT	DX74M	DX74HP	DX3MI	DU04
Chemical Name	Modified Azodicarbonamide				
Chemical Formula	$H_2N-CO-N=N-CO-NH_2$				
Appearance	Fine Yellow Powder				
Decomposition Temperature (℃)	150~154	138~141	173~176	152~160	197~202
Gas Volume (ml/g, at 25℃)	125~135	145~165	162~182	175~185	190~210
Average Particle Size (㎛)	5.0~5.5	*11.5~13.5	6.0~7.0	5.7~6.3	*5.0~6.0
Moisture Content (%)	0.5 max.	0.5 max.	0.5 max.	0.3 max.	0.3 max.
Application	EVA Press Molding and Injection				PVC Extrusion

*Measured by Laser Particle Sizer

Applications

UNICELL-DX & DU series is particularly suited for shoe soles, and the other grades are usually used for EVA or Rubber press molding and PVC extrusion systems.

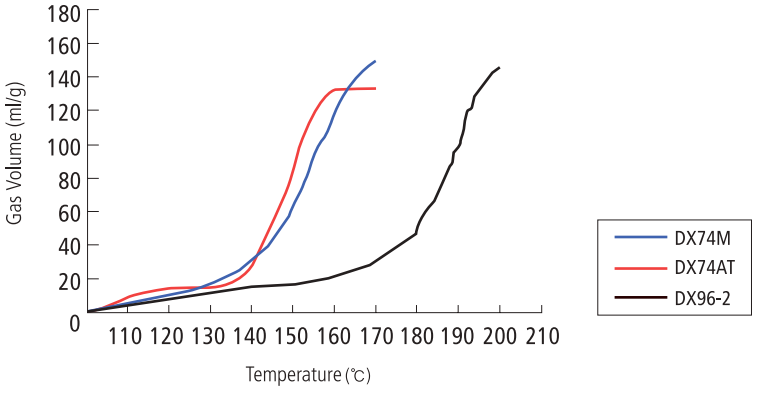


Fig. Decomposition behaviors of **UNICELL-DX** series depending on time

UNICELL-D1500 Series

• Modified Azodicarbonamide (Azobisfomamide)
• Specially designed foaming agents for crosslinked LDPE or PP foam

Description

UNICELL-D1500 series, the registered trade name of modified Azodicarbonamide, is specially recommended as effective foaming agent for the crosslinked LDPE or PP foams.
The decomposition residues of **UNICELL-D1500** series are non-toxic, non-staining, odorless, non-flammable, and colorless and can be introduced making micro cellular structures.
They can be dispersible easily into polyethylene and polypropylene, moreover it is unnecessary to add extra crosslinking co-agents and foaming activators in order to produce regular fine white foams with smooth surfaces.
UNICELL-D1500 series is stable under ordinary conditions and compounding processes.
They are selected depending on the process condition without any additives.

Properties of UNICELL-D1500 series

Chemical Crosslinking Process

Item	Specification				
Grade Name	D1500PE	D1500TSK	DT08	YCE	TL
Chemical Name	Modified Azodicarbonamide				
Chemical Formula	$H_2N-CO-N=N-CO-NH_2$				
Appearance	Fine Yellow Powder				
Decomposition Temperature (℃)	181~185	198~202	200~204	196~200	197~203
Gas Volume (ml/g, at 25℃)	200~220	220~240	220~240	220~240	225~245
Average Particle Size (㎛)	*11.5~15.5	*11.5~15.5	*14.0~17.0	*11.0~15.0	*16.0~20.0
Moisture Contentor Heat Loss (%)	0.6 max.	1.3 max.	0.5 max.	0.8 max.	0.8 max.

* Measured by Laser Particle Sizer

Applications

General applications of polyethylene foams with **UNICELL-D1500** series are ;
- Thermal insulations
- Floatings
- Packaging materials
- Sports and leisure goods
- Life jackets
- Chemical crosslinking foams

Electron Beam Radiation Crosslinking Process

Item	Specification				
Grade Name	D1000CS	D1500TID	D1500CS	D30CSK	D3000CS
Chemical Name	Modified Azodicarbonamide				
Chemical Formula	$H_2N - CO - N = N - CO - NH_2$				
Appearance	Fine Yellow Powder				
Decomposition Temperature (℃)	204~208	202~205	200~202	204~208	204~208
Gas Volume (ml/g, at 25℃)	225~245	220~240	215~225	225~245	225~245
Average Particle Size (㎛)	*11.0~14.0	*11.5~14.5	*22.0~26.0	*23.5~27.0	*24.5~26.5
Moisture Contentor Heat Loss (%)	0.08 max.	0.3 max.	0.08 max.	0.08 max.	0.08 max.

* Measured by Laser Particle Sizer

Applications

General applications of polyethylene foams with **UNICELL-D1500** series are ;

- Thermal insulations
- Floatings
- Packaging materials
- Sports and leisure goods
- Life jackets
- Electron beam radiation crosslinking foams

UNICELL-MT Series

• Master-batch pellet of Modified Azodicarbonamide
• High quality foams by Injection and Compress molding process

Description

UNICELL-MT series has been developed specially as MASTER-BATCH of foaming agent for the expansion of EVA resin.
UNICELL-MT series consists of EVA resin and foaming agent
UNICELL-MT series is based on Azodicarbonamide.
The following advantages are obtained by using **UNICELL-MT** series for the expansion of EVA resin.
-Prevention from scattering the foaming agent
-Reduction of the time for mixing with base resin
-Excellent storage stability
-Reduction of possibilities of fire and explosion
-Prevention from reduction of physical properties of foam by containing almost same VA content EVA resin with other EVA resins used for manufacturing
-Providing whiter and more uniform cell structure

Properties of UNICELL-MT series

Item	DX74MT	DX74HPMB	D600MT	DX3MT	DX3MTF
Appearance	Pale Yellow Pellet	Pale Yellow Pellet	Yellow Pellet	Pale Yellow Pellet	Pale Yellow Pellet
Decomposition Temperature (℃)	143~148	166~172	202~206	155~160	145~150
Gas Volume (ml/g)	75~85	85~95	125~135	95~105	85~95
Contents of Foaming Agent (%)	55	55	50	55	55
VA Contents of EVA (%)	21			22	

Applications

UNICELL-MT series can be used for general purpose compression molding of EVA or blended EVA with natural/synthetic rubbers, polyethylene and specially in manufacturing shoe soles and phyron sponges.
UNICELL-MT series can be used for manufacturing extrusion and injection molding foams of PE, TPR, TPE etc.
UNICELL-DX3MTF is specially designed for products including fluorescent pigments.

UNICELL-AD Series

• Modified Azodicarbonamide (Azobisfomamide)
• Foaming agents for low temperature process

Description

UNICELL-AD series is broadly used economic foaming agent for thermoplastics and rubbers. **UNICELL-AD** series is applied in low temperature process. **UNICELL-AD** series can produce regularly white cellular materials and reduce the curing time, thereby save energy and ingredient costs.

Properties of UNICELL-AD series

Item	Specification				
Grade Name	ADST	AD#1	AD#2	AD#3 (AD300)	ADP#3
Chemical Name	Modified Azodicarbonamide				
Chemical Formula	$H_2N-CO-N=N-CO-NH_2$				
Appearance	Fine Yellow Powder				
Decomposition Temperature (℃)	132~138	132~138	132~138	132~138	132~138
Gas Volume (ml/g, at 25℃)	120~130	120~130	120~130	115~135	110~120
Average Particle Size (㎛)	5.0~6.0	6.0~7.0	5.0~6.0	5.0~6.0	5.0~6.0
Moisture Content (%)	0.5 max.	0.5 max.	0.5 max.	0.5 max.	0.5 max.
Application	Compressing molding of EVA, EVA-PE blending resin, PE and rubbers				

Applications

UNICELL-AD series is broadly used for general purpose compression molding of EVA copolymer, EVA and PE blending resin, polyethylene, and Rubbers.
UNICELL-AD series provides fine and uniform structures and can produce white cellular products.

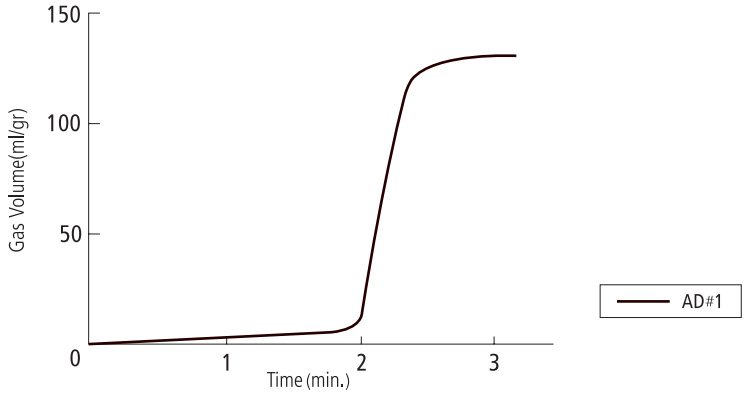


Fig. Decomposition behavior of **UNICELL-AD** series at the constant temperature of 160℃

UNICELL-DWP Series

• Modified Azodicarbonamide (Azobisfomamide)
• Specially designed foaming agents for expanded PVC wall coverings

Dongjin Semichem co., Ltd.

Description

UNICELL-DWP series has been designed specially to be used in expanded PVC wall coverings. Besides of advantage of solid vinyl wall coverings, they have some merits ;

- Design in depth
- Increasing thermal insulation
- Reduction in weight with consequent saving of raw materials
- Providing whiter foams

Properties of UNICELL- DWP series

Item	Specification					
Grade Name	DWPX03	DX77N	KD10	PL05	DW007	DW009
Chemical Name	Modified Azodicarbonamide					
Chemical Formula	$H_2N-CO-N=N-CO-NH_2$					
Appearance	Fine Yellow Powder					
Decomposition Temperature (℃)	176~179	143~147	142~148	167~173	160~165	152~158
Gas Volume (ml/g, at 25℃)	215~240	170~180	140~160	200~220	170~180	155~165
Average Particle Size (㎛)	2.8~3.2	6.0~7.0	4.0~4.5	2.8~3.2	2.8~3.2	2.8~3.2
Moisture Content (%)	0.3 max.	0.5 max.	0.5 max.	0.5 max.	0.3 max.	0.5 max.
Application	PVC wall coverings					

* Measured by Laser Particle Sizer

Applications

UNICELL-DWP series is particularly suitable for PVC wall coverings in the process of spread coating. **UNICELL-DWP** series can be used for mechanical or chemical embossing process.

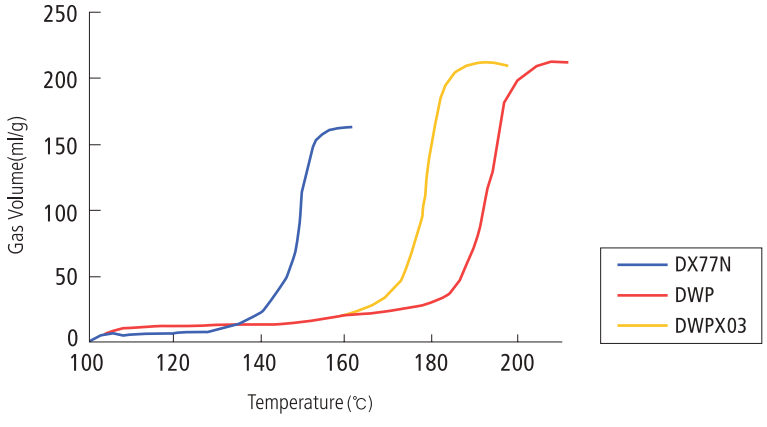


Fig. The decomposition behaviors of **UNICELL-DWP** series when heating speed is 3.3℃/min.

UNICELL-OH Series

• p.p'-Oxybis(benzenesulfonylhydrazide)
• General purpose foaming agents

Description

UNICELL-OH series is an outstanding non-staining, non-discoloring, non-toxic, odorless, nitrogen releasing foaming agent for the production of both cellular rubbers and plastics. Among the latter, PE, PVC, EPOXY, TPR and PHENOLIC resins are currently expanded on a commercial scale with these foaming agents. It can be used also in the production of thermal insulation materials based on blend of synthetic rubbers and thermoplastics, e.g., NBR-PVC. **UNICELL-OH** series produces ammonia-free gas by thermal decomposition. Decomposition temperature of **UNICELL-OH** series is well matched with the conventional curing temperature range. **UNICELL-OH** series therefore provides good foaming efficiency at conventional curing temperature without activators. Furthermore, **UNICELL-OH** series has no effect on the cure of rubber or on the stability of PVC.

Properties of UNICELL-OH series

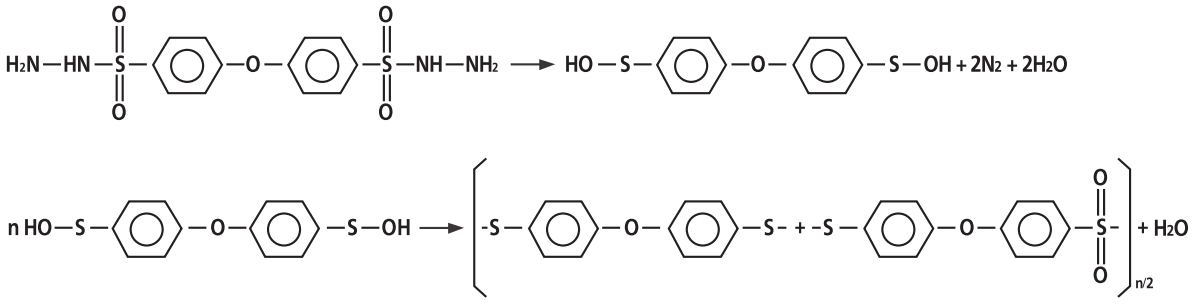
Item	Specification			
	OH	OH300N	OHW2	OHC
Chemical Name	p.p'-Oxybis(benzenesulfonylhydrazide)			
Appearance	White Fine Powder			
Decomposition Temperature (℃)	157~163	157~163	157~163	157~163
Gas Volume (ml/g, at 25℃)	119~129	120~130	115~125	121~131
Average Particle Size (㎛)	3.2~4.2	2.9~3.3	4.0~4.5	5.0~6.0
Moisture Content (%)	0.5 max.	0.5 max.	0.5 max.	0.5 max.
Ash Content (%)	-	-	-	-
pH	6.0~8.0	6.0~8.0	6.0~6.8	6.0~8.0
Sieve Test (100mesh, max. %)	0.05	0.05	0.05	0.05
Chemical Formula	$H_2N-NH-SO_2-\phi-O-\phi-SO_2-NH-NH_2$			
Molecular Weight	358.40			
Specific Gravity	1.55			
Solubility (g sample/100g solvent, at 20℃)	Soluble in Water : 0.02 Toluence : 0.07 Benzene : 0.13 MEK : react DNF : react DMSO : very soluble			
CAS No.	80 - 51 - 3			

Applications

UNICELL-OH series can be used in the foaming of PVC, EPDM, EVA, LDPE, CR and other resin processing. **UNICELL-OH** series is suitable for plastisol and calendaring of PVC, extrusion, injection molding and other processing with thermoplastics.

Decomposition of UNICELL-OH Series

In the decomposition of **UNICELL-OH**, Nitrogen gas is produced as follows;



Solid residue is the non-polar aromatic sulfur containing polymer, which is approximately 84% of the origin weight of **UNICELL-OH**.

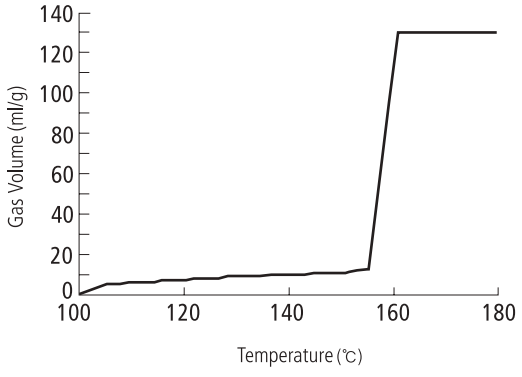


Fig1. The decomposition behavior of **UNICELL-OH** when heating speed is 5℃/min.

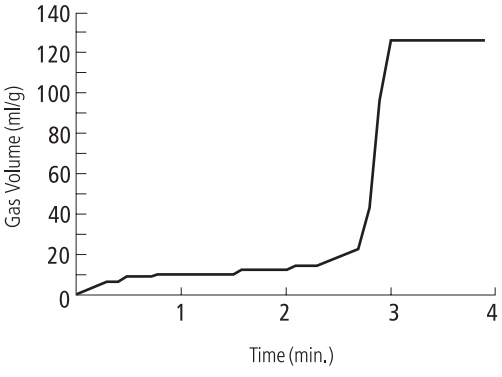


Fig2. The decomposition behavior of UNICELL-OH at the constant temperature of 160℃

Activation

The decomposition temperature of **UNICELL-OH** can be lowered by some kinds of activators. The effect of activation on the decomposition of **UNICELL-OH** variably depends on the kind of activators and process conditions.

Table2. The kinds of Activators for **UNICELL-OH**

Very Strong Activators	UNIPASTE-PII
Strong Activators	DPG (Diphenyl guanidine)
Moderate Activators	Calcium Oxide, Calcium stearate, Stearic acid and Vinyl stabilizer (Cd, Pb type)
Weak Activators	Adipic acid, Benzoic acid, Citric acid, Salicylic acid, Lead and Zinc stearate

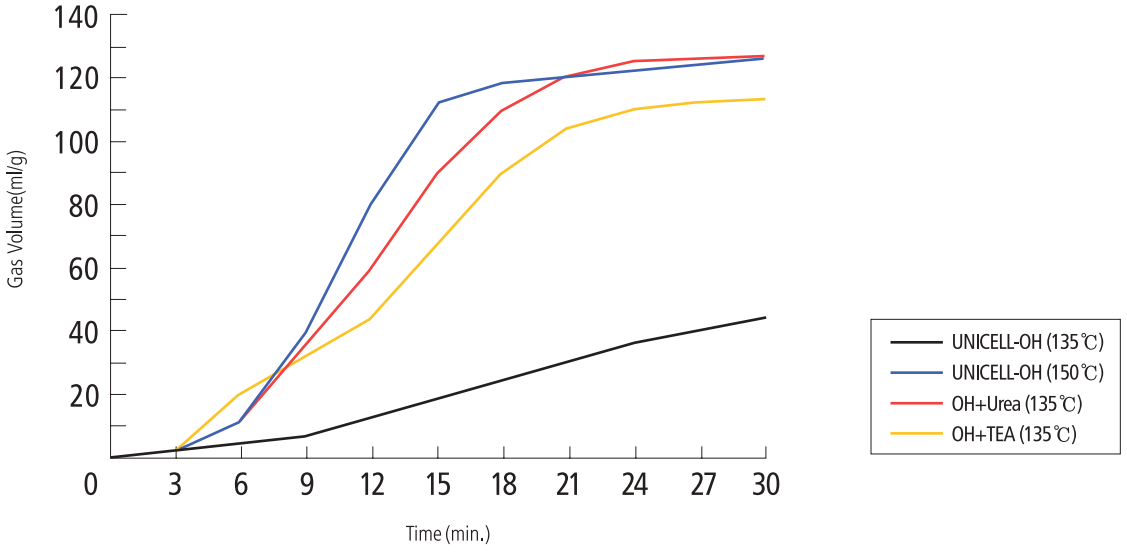


Fig3. The decomposition behavior of **UNICELL-OH** at constant temperature

Material Safety Data

Hazards

Harmful if swallowed.
Causes skin irritation.
May cause an allergic skin reaction.
Causes serious eye irritation.
Suspected of causing genetic defects.
Toxic to aquatic life with long lasting effects.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides, Sulfur oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust.
Conditions of storage : Keep only in the original container in a cool and well-ventilated place away from sources of ignition.
Storage with other products : Keep away from food, drink and animal feeding stuffs.

Stability and Reactivity

Conditions to avoid : Keep away from sources of ignition – No smoking.
Dangerous reactions : May occur with strong oxidizing agents.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 1,500 mg/kg
Skin : May cause slight irritation.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

FDA Compliance

Oxybis (benzenesulfonylhydrazide) can be used in the following FDA regulated applications.
section 121.2550 : Closure sealing gaskets in contact with food 0.5% max.
section 177.2600 : Rubber articles in contact with food 5% max.
section 121.2514 : Resinous & polymeric coatings 0.5% max.

Other Information

Separate Health and Safety Data Sheets on P, P´- Oxybis(benzenesulfonyl hydrazide) are available on request.

UNICELL-H Series

- p-Toluenesulfonylhydrazide
- Specially designed foaming agents for rubbers and plastics

Description

UNICELL-H series, the trade name of p-Toluenesulfonylhydrazide, produces non-discoloring and low odored cellular foams. **UNICELL-H** series is designed for regular opened/closed rubber foams and fine cellular structures. It has excellent performance without activators at conventional curing temperature.

UNICELL-H series is recommended for the less shrinkable materials when exposed to light or heat.

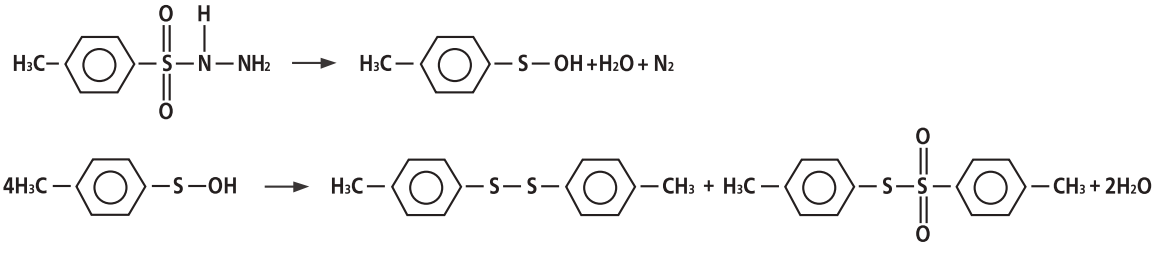
UNICELL-H series also has commercial applications for thermosetting polyesters and PVC sealants.

Properties of UNICELL-H series

Item	Specification	
Grade Name	H	H (HC)
Chemical Name	p-Toluenesulfonyhydrazide	
Appearance	Fine White Powder	
Decomposition Temperature (℃)	143~147	143~147
Gas Volume (ml/g, at 25℃)	105~115	95~105
Average Particle Size (㎛)	5.6~6.0	
Moisture Content (%)	0.5 max.	
Chemical Formula	$H_3C-\phi-SO_2-NH-NH_2$	
Specific Gravity	1.42	
Molecular Weight	186.23	
Solubility (g sample/100g solvent, at 20℃)	Soluble in Water : 0.49 Toluence : 0.35 Alcohol : 5.1 DMSO : fairly soluble	
CAS No.	1576 - 35 - 8	

Decomposition of UNICELL-H series

A Possible decomposition mechanism of **UNICELL-H** series has been suggested as follows;



UNICELL-H releases N_2, H_2O and p-toluenesulfonic acid as an unstable intermediate, when heated.
The unstable p-toluene sulfonic acid turns into ditolyl disulfide and tolyl paratoluene thiosulfonate immediately.
The sulfur containing decomposition residues can function as curing agents in rubber compositions.

Applications

The decomposition rate of **UNICELL-H** series is suitable for the low processing temperature without any decomposition activators. **UNICELL-H** series requires careful adjustment of the processing condition in order to prevent the loss of foaming efficiency. And **UNICELL-H** series causes a marked activation of the cure during the foaming process, therefore the addition of secondary accelerators is usually unnecessary.

Material Safety Data

Hazards

Heating may cause a fire.
Toxic if swallowed.
Causes serious eye irritation.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides, Sulfur oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust.
Conditions of storage : Keep only in the original container in a cool and well-ventilated place away from sources of ignition.
Storage with other products : Keep away from food, drink and animal feeding stuffs.

Stability and Reactivity

Conditions to avoid : Keep away from sources of ignition – No smoking.
Dangerous reactions : May occur with strong oxidizing agents, strong acids, strong bases and heavy metal salts.
Hazadous decomposition : Carbon monoxide, nitrogen oxides, sulfur oxides, ammonium toluene sulfonamide and toluene sulfonamide.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 283 mg/kg
Skin : Not irritating.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

Separate Health and Safety Data Sheets on p-Toluenesulfonyl hydrazide products are available on request.

UNICELL-BSH Series

- Benzenesulfonylhydrazide
- Specially designed foaming agents for white cellular rubbers

Description

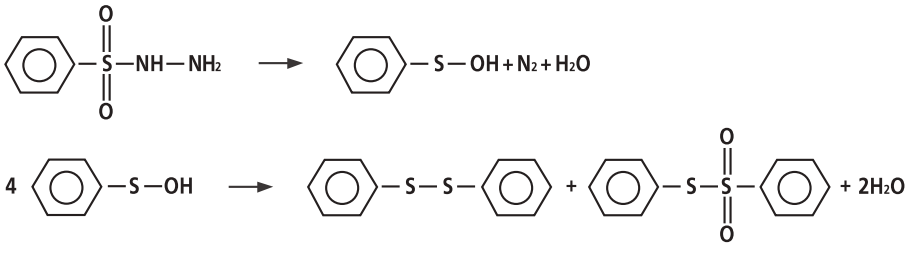
UNICELL-BSH series, the trade name of Benzenesulfonylhydrazide, can produce non-discoloring and non-objectionable odor cellular foams. **UNICELL-BSH** series is designed for opened or closed cellular rubbers which have regular and fine cell structure. They have excellent performance without activators at conventional curing temperature conditions. **UNICELL-BSH** series is especially recommended for materials that shrink when exposed to light or heat.

Properties of UNICELL-BSH series

Item	Specification		
Grade Name	BSH	BSH paste	BSHNE
Chemical Name	Benzenesulfonylhydrazide		
Appearance	Fine White Powder		
Decomposition Temperature (℃)	143~147	143~147	142~146
Gas Volume (ml/g, at 25℃)	100~110	80~90	98~108
Average Particle Size (㎛)	3.0~4.0	3.0~4.0	3.0~4.0
Moisture Content (%)	0.5 max.	0.5 max.	0.5 max.
Chemical Formula	$\phi - SO_2 - NH - NH_2$		
Specific Gravity	1.48		
Molecular Weight	172.2		
Solubility (g sample/100ml solvent, at 20℃)	Water : 0.49 Toluence : 0.35 Alcohol : 5.10 DMSO : fairly soluble		
CAS No.	80 - 17 - 1		

Decomposition of UNICELL-BSH series

One possible decomposition mechanism of **UNICELL-BSH** is ;



When heated, **UNICELL-BSH** decomposes into N_2 gas and H_2O with benzene sufonic acid as an unstable intermediate. The unstable benzene sulfonic acid turns into dibenzyl disulfide and phenyl benzene thiosulfonate immediately. The sulfur containing residues can function as curing agents in rubber composition.

Applications

The decomposition rate of **UNICELL-BSH** series is slightly faster than **UNICELL-H** and suitable for low processing temperatures without any decomposition activators. **UNICELL-BSH** series requires careful adjustment of the processing condition in order to prevent loss of foaming efficiency. **UNICELL-BSH** series causes a marked activation of the cure during the foaming process, therefore the addition of secondary accelerators is usually unnecessary.

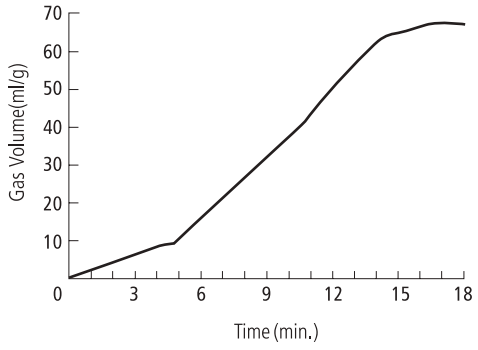


Fig. The decomposition behavior of **UNICELL-BSH** at constant temperature of 150℃

Material Safety Data

Hazards

Heating may cause a fire.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides, Sulfur oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust. No smoking.
Conditions of storage : Keep only in the original container in a cool and well-ventilated place away from sources of ignition.

Toxicological Information

Acute aral toxicity : No data available
Skin : May cause slight irritation.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

Separate Health and Safety Data Sheets on Benzenesulfonyl hydrazide products are available on request.

UNICELL-G Series

• N,N'-Dinitrosopentamethylenetetramine
• The most economic foaming agents for rubber foams

Description

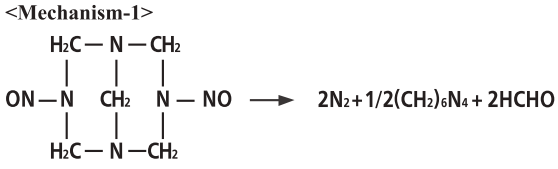
UNICELL-G series, the trade name of dinitrosopentamethylenetetramine, is well known as the oldest and most economic foaming agent for plastics and rubbers. And they are non-staining and non-discoloring.
UNICELL-G series is usually mixed with oils and inorganic fillers in order to increase the stabilities.

Properties of UNICELL-G series

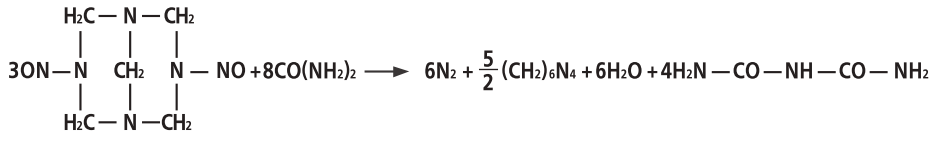
Item	Specification			
Grade Name	G (100%)	GP9	GP3	GP5
Chemical Name	N,N'-Dinitrosopentamethylene tetramine			
Appearance	Fine Lemon Yellow Powder			
Decomposition Temperature (℃)	197~203	197~203	197~203	202~208
Gas Volume (ml/g, at 25℃)	200~210	200~210	185~195	165~175
Moisture Content (%)	0.5 max.			
Chemical Formula	$C_5H_{10}N_6O_2$			
Specific Gravity (at 25℃)	1.45			
Decomposition Heat (kcal / mol)	100			
Molecular Weight	186.17			
Solubility (g sample/100ml solvent, at 20℃)	Soluble in Water : 0.48 MEK : 1.6 Alcohol : 0.3 Insoluble in almost organic solvents. Can be exploded by strong acid, strong base and other oxidizing agent.			
CAS No.	101 - 25 - 7			

Decomposition of UNICELL-G series

<Mechanism-1>



<Mechanism-2>



When **UNICELL-G** is decomposed alone by heat **(Mechanism-1)**, 2 moles of nitrogen gas and 2 moles of formaldehyde and 0.5 mole of hexamethylene tetramine are preduced per 1 mole of **UNICELL-G**.
The formaldehyde and hexamethylene tetramine give rise to unpleasant odor in the foams.
The odor can be partially reduced by the addition of urea, melamine and certain amino compounds. Therefore, When **UNICELL-G** is decomposed with UNIPASTE series **(Mechanism-2)**, unpleasant odor is reduced.
If **UNICELL-G** is contacted with strong acids, it immediately decomposes and may cause fire.

The decomposition speed of **UNICELL-G** can be increased by the addition of chemicals, such as salicylic acid, phthalic anhydride, and urea based compounds **(UNIPASTE)**. Among these activators, urea based compounds are best because it can increase storage stability and more suitable for the vulcanizing system of rubbers.

Applications

UNICELL-G series is one of the widely used foaming agents in rubber industry, but they have limitations in plastics because of the high decomposition exothermic calory and the unpleasant odor of the residue.

Material Safety Data

Hazards

Flammable solid.
May be fatal if swallowed and enters airways.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust.
Conditions of storage : Keep only in the original container in a cool and well-ventilated place away from sources of ignition.
Storage with other products : Keep away from food, drink and animal feeding stuffs.

Stability and Reactivity

Conditions to avoid : Keep away from sources of ignition – No smoking.
Dangerous reactions : May occur with strong oxidizing agents, strong acids, strong bases and heavy metal salts.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 940 mg/kg
Skin : Not irritating.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

Separate Health and Safety Data Sheets on N,N'-Dinitrosopentamethylene tetramine products are available on request.

UNICELL-TS

- p-Toluenesulfonylsemicarbazide
- Foaming agent for high temperature process

Description

UNICELL-TS, the trade name of p-Toluenesulfonylsemicarbazide, evolves gas at the relatively higher decomposition temperatures than foaming agents.
The high decomposition temperature of **UNICELL-TS** gives less risk of premature decomposition in compounding stage where high temperatures are required. **UNICELL-TS** is recommended to use in ABS, rigid PVC, polyamide, HDPE, Polysulfone and other polymers requiring high processing temperature.

Properties of UNICELL-TS

Item	Specification
Chemical Name	p-Toluenesulfonylsemicarbazide
Appearance	Fine White Powder
Decomposition Temperature (℃)	228~232
Gas Volume (ml/g, at 25℃)	115~155
Average Particle Size(㎛)	4.0~4.6
Moisture Content (%)	0.5 max.
Chemical Formula	$CH_3-\phi-SO_2-NH-NH-CO-NH_2$
Specific Gravity (at 25℃)	1.44
Molecular Weight	299.25
Solubility (g sample/100ml solvent, at 20℃)	Soluble in Water : 0.49 Toluene : 0.35 Alcohol : 5.10 DMSO : fairly soluable
CAS No.	10396 - 10 - 8

Decomposition of UNICELL-TS

When **UNICELL-TS** decomposes, nitrogen and carbon dioxide are evolved.

$$R-SO_2-NH-NH-CO-NH_2 \longrightarrow R-SO_2-N=N-CO-NH_2 + H_2O$$

$$R-SO_2-N=N-CO-NH_2 + H_2O \longrightarrow R-SO_2-N=N-COOH + NH_3$$

$$R-SO_2-N=N-COOH \longrightarrow R-SOH + N_2 + CO_2$$

$$R-SOH + NH_3 \longrightarrow R-S-S-R + R-SO_3-NH_4 + 2H_2O$$

$$3NH_3 + 2CO_2 + H_2O \longrightarrow (NH_4)HCO_3 + H_2NCOO-NH_4$$

※ R : $CH_3-C_6H_4-$

Several compounds have been found to activate the decomposition of **UNICELL-TS**. Because of this activation, **UNICELL-TS** is applicable to low processing temperature plastics. General activators are; **UNIPASTE** series, zinc oxide, zinc stearate, calcium stearate, lead stearate and zinc chloride.

Applications

The decomposition rate of **UNICELL-TS** is suitable for high processing temperature with ABS, low melt index Polyolefins, impacted PS, and Engineering plastics.
UNICELL-TS offers improved surface appearance in structural foams in the processes of injection molding, and extrusion.
UNICELL-TS often enables the use of high temperature with resin which can also be foamed with azodicarbonamide, therefore, it can increase the productivity of customers.
The decomposition temperature of **UNICELL-TS** can be lowered by activators, and **UNICELL-TS** is applicable to white PVC products without high loading of titanium dioxide which reduces the physical properties.

Material Safety Data

Hazards

Harmful if swallowed.
Harmful in contact with skin.
Causes serious eye irritation.
May cause respiratory irritation.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides, Sulfur oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust.
Conditions of storage : Keep only in the original container in a cool and well-ventilated place away from sources of ignition.
Storage with other products : Keep away from food, drink and animal feeding stuffs.

Stability and Reactivity

Conditions to avoid : Keep away from sources of ignition – No smoking.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 991 mg/kg
Skin : Not irritating.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

Separate Health and Safety Data Sheet on P-Toluenesulfonyl semicarbazide products are available on request.

UNICELL-C Series

- Surface coated Citric acid and Sodium bicarbonate
- Specially Designed Foaming Agents for cellular plastics

Description

UNICELL-C series, a group of inorganic compounds, is well known as effective foaming and nucleating agent for plastics such as PS, ABS, PE, PP and modified PPO.
Usual foaming agents are exothermic systems which liberate large amounts of heat during decomposition. This ordinarily leads to irregular cell structure and local overheating especially in the marginal zones. Contrary to most foaming agents, **UNICELL-C** series has endothermic decomposition characteristics.
UNICELL-C series is white, odorless, non-toxic and free-flowing powder and releases carbon dioxide and water vapor during thermal decomposition. It gives no incrustation against screw and hopper, allowing extruder to operate for a long time before cleaning is necessary.
All ingredients of **UNICELL-C** series meet FDA regulations and can be used for food stuffs.

Properties of UNICELL-C series

Item	Specification							
Grade Name	C#850	C#309	C#129	C#709	C#850MT	C#709MT	DX820	DX920
Chemical Name	Specially coated sodium bicarbonate				Masterbatch types of C#grades		Modified sodium bicarbonate	
Appearance	Fine White Powder				White pellet		Pale Yellow Powder	
Decomposition Temperature (℃)	150~220	155~165	155~165	155~165	150~220	155~165	150~180	140~170
Gas Volume (ml/g, at 25℃)	110~130	140~160	140~160	140~160	35~45	45~50	120~160	110~150
Average Particle Size (㎛)	5.2~6.2	6.0~7.0	6.0~7.0	6.0~7.0	-	-	-	-
Solubility (g sample/100ml solvent)	Soluble in water and insoluble in organic solvents							

Decomposition of UNICELL-C series

UNICELL-C series is decomposed endothermically. The decomposition range is 150~220℃.
The use of activators is neither necessary nor possible. Decomposition only depends on the quantity of heat and processing condition, e.g. friction and pressure.
It does not produce any ammonia odor but evolve only carbon dioxide and water vapor. And it only leaves white decomposition residue.

Applications

UNICELL-C series allows smaller cells with regular distribution (by nucleating effect) and smooth surface (easy lacquer coating) than Azodicarbonamide. It is free from discoloring troubles.
UNICELL-C series can be used in both extrusion and injection molding system. The recommended dosage level is 0.2~1.0% by weight. In practical usages, the processing temperature of 180~230℃ is suitable.
UNICELL-C series can be also widely used as a nucleating agent to directly gas thermoplastics such as Polyolefines, Polystyrene, EVA and PVC using freon, pentane, butane, nitrogen and carbon dioxide.
It will nucleate the high pressure gases into fine cellular structure in many different thermoplatics such as PS, ABS, PE, PP, and modified PPO by the processes of injection and extrusion system.

Table. Selection guide for **UNICELL-C** series

Grade Name	PS	LDPE	HDPE	PP	ABS	PVC
UNICELL-C#850	○	○	○	○	○	○□
UNICELL-C#850MT	○	○	○	○	○	○□
UNICELL-C#309	○□	○□	○□	○	○	○□
UNICELL-C#129	○□	○□	○□	○	○	○□
UNICELL-C#709	○□	○□	○□	○	○	□
UNICELL-C#709MT	○□	○□	○□	○	○	□

○ : as a foaming agent □ : as a nucleating agent

Material Safety Data

Hazards

Risk of explosion if heated under confinement.

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

UNICELL-C series is absolutely safe in storage and handling.
After removing the heat source, decomposition stops (an advantage of endothermic characteristic) while other foaming agents's decomposition continue evolving large quantities of heat. Spill should be removed by means of vacuum cleaning, and containers should remain closed when not in use.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 4,220 mg/kg
Skin : May cause slight irritation.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

Separate Health and Safety Data Sheets on Citric Acid and Sodium Bicarbonate are available on request.

UNIPASTE-P2 Series

• Surface coated Urea
• Urea based activators for foaming agents

Description

UNPASTE series is very strong urea based activators for **UNICELL-D**, **UNICELL-OH**, **UNICELL-TS** and **UNICELL-G**. It is used in order to adjust the decomposition temperature to be suitable for the processes. To prevent moisture absorption and agglomeration, **UNIPASTE** series is coated with fatty acid or metal soap.

UNIPASTE series is especially recommended for rubbers and plastic foams with **UNICELL-G** because it can reduce unpleasant odor caused by the thermal decomposition of **UNICELL-G**. **UNIPASTE** series is an essential ingredient for rubber compositions containing **UNICELL-G**. **UNIPASTE** series also activates the rate of crosslinking or cure because of their basic characteristics. Therefore it can decrease the quantity of accelerator.

All **UNIPASTE** series is non-staining, non-discoloring, odorless and completely dispersed into resin matrixes.

In combination with **UNIPASTE** series, foaming agents release gases at lower temperature, So they can reduce energy costs and be useful where heat sensitive substrates are being used or when reduction of plasticizer fumes is necessary.

Moreover, they give whiter foams than that of pure foaming agent. Coatings which are expanded with foaming agent and **UNIPASTE** combinations are free from discoloring and enable to decrease the quantity of titanium dioxide without any sacrifice in whiteness.

Properties of UNIPASTE Series

Item	Specification			
Grade Name	P2	N3	N3M	N3S
Chemical Name	Urea derivatives			
Appearance	Fine White Powder			
Decomposition Temperature (℃)	132~138	132~138	132~138	132~138
Gas Volume (ml/g)	120~130	120~130	120~130	120~130
Average Particle Size (㎛)	4.0~6.0	2.6~3.4	2.6~3.4	4.0~6.0
Moisture Content (%)	0.3 max.	0.3 max.	0.3 max.	0.3 max.

※ Decomposition temperature and Gas volume are measured when mixed with **UNICELL-G** in the ratio of 1 : 1

Decomposition of UNIPASTE Series

UNIPASTE series activates **UNICELL-D**, **UNICELL-OH**, **UNICELL-TS** and **UNICELL-G** to decompose at considerably lower temperature. Though the decomposition temperature of foaming agents is lowered gradually with increasing amounts of **UNIPASTE** series, and **UNICELL-G** is more activated than **UNICELL-D**, **UNITELL-OH** and **UNICELL-TS**.

When combined with **UNICELL-G**, **UNIPASTE** can reduce formaldehyde which comes from **UNICELL-G**. Formaldehyde causes unpleasant odor in foams which are expanded with only **UNICELL-G**.

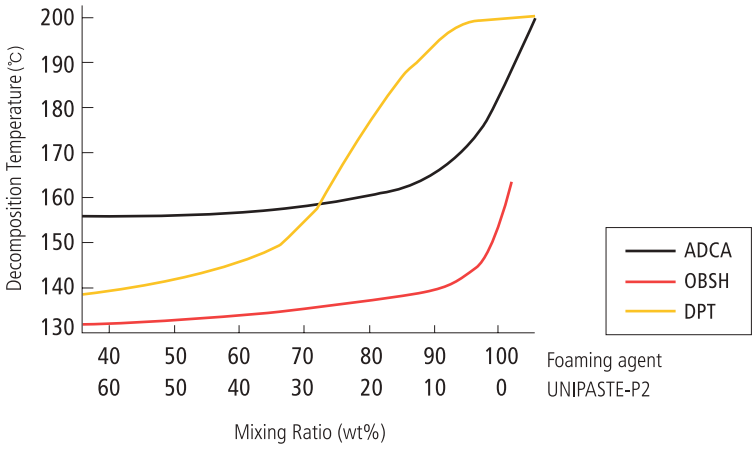


Fig. The activation effects of **UNIPASTE-P2** on **UNICELL-D**, **UNICELL-G** and **UNICELL-OH**

Material Safety Data

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Nitrogen oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Handling and Storage

Handling : Do not breathe dust.
Conditions of storage : Keep only in the original container at temperature not exceeding 50℃.
Keep in cool, well ventilated place.
Storage with other products : Keep away from food, drink and animal feeding stuffs.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 8,471 mg/kg
Skin : May cause slight irritation.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

Separate Health and Safety Data Sheets on urea products are available on request.

UNICELL-BM/TM

• Zinc dibenzene sulfinate & Zinc ditoluene sulfinate
• Organometallic activator

Description

UNICELL-BM/TM are very strong organometallic activators for **UNICELL-D**. They adjust the decomposition temperature to be suitable for the process.
In combination with **UNICELL-BM/TM**, the foaming agents release gases at lower temperature they reduce energy costs and are useful where thermosensitive substrates are being used or when reduction in plasticiser fumes is necessary. Moreover they give whiter foams than that of pure foaming agents. Coatings expanded with **UNICELL-BM/TM** combinations are free of discoloring and enable to decrease the quantity of titanium dioxide without any sacrificing whiteness.

Properties of UNICELL-BM/TM

Item	Specification	
Grade Name	BM	TM
Chemical Name	Zinc-dibenzensulfinate	Zinc-ditoluenesulfinite
Appearance	Fine White Powder	
Average Particle Size (㎛)	2.0~4.0	2.0~4.0
Moisture Content (%)	5.0 max.	5.0 max.
Sieve Test (On 100mesh)	nil	nil
Melting Point (℃)	218~228	255~265
Molecular Weight	347.63	375.65
CAS No.	24308 - 84 - 7	24345 - 02 - 6

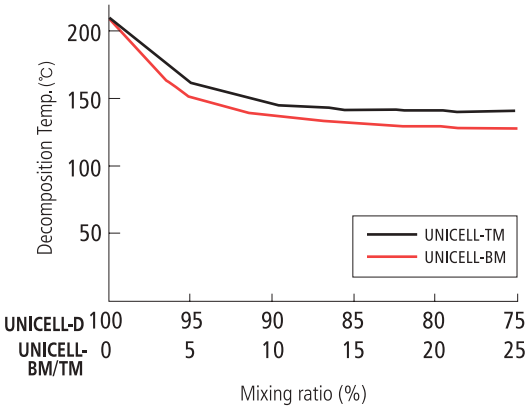


Fig1. The decomposition temperature of **UNICELL-D** mixture with **UNICELL-BM/TM**

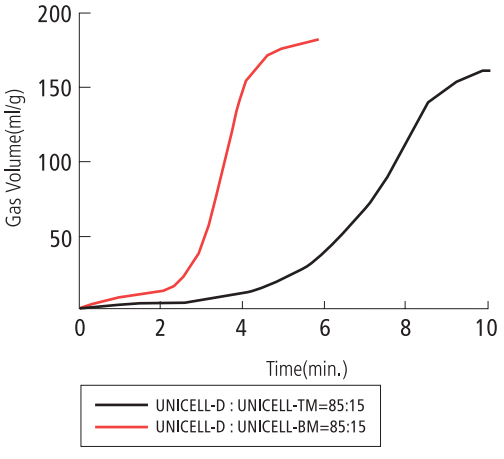


Fig 2. The decomposition behavior of **UNICELL-D** of the constant temperature of 160℃
(mixing ratio.
UNICELL-D: UNICELL-BM/TM=85:15)

Material Safety Data

Hazards

May cause skin irritation
May cause eye irritation
May cause respiratory irritation

First-Aid Measure

General recommendations : Take off immediately all contaminated clothing.
Eye contact : Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Skin contact : Wash off with soap and plenty of water. Consult a physician.
Inhalation : If breathed in, move person into fresh air. If not breathing give artificial respiration Consult a physician.
Ingestion : Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Fire-Fighting Measure

Extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Combustion products: Carbon oxides, Zinc oxides, Sulfur oxides.
Fire fighting equipments : Wear self contained breathing apparatus for fire fighting.

Toxicological Information

Acute aral toxicity : LD50(oral,rat) > 2,000 mg/kg
Skin : May cause slight irritation.
Eyes : May cause slight irritation.
Respiratory : May cause slight sensitization.

Other Information

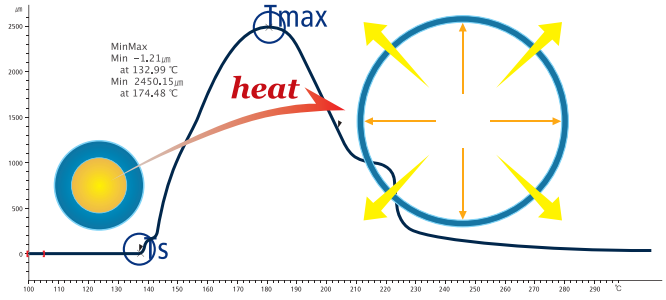
Separate Health and Safety Data Sheets on zinc dibenzene sulfinate and ditoluene sulfinate are available on request.

UNICELL-MS Series

Description

UNICELL-MS series is a thermal expandable microsphere.
It is an unexpanded type which is composed of polymeric shell and volatile core.
These particle sizes range from 10 to 100㎛. Densities range from 1.05 to 1.20g/cc.

Structure and Expansion Mechanism



Dongjin Lab

Feature
- Excellent expandability and thermal stability
- Excellent solvent resistance
- Various grades and wide choice
- Suitability for customers' demands

When UNICELL-MS is heated to Tg of its shell, It starts expanding dramatically. We call this point **Ts**. And more heated, It expands to about 40~50 times volumetrically. Its shell thins down critically and it forms hollow sphere. We call this point **Tmax**. If it is more heated above Tmax or for long time, the particle may shrink or collapse.

Products

Dry type

Item	Specification			Application
	APS(㎛)	Ts(℃)	Tmax(℃)	No.
MS140DS/D	15±5 / 25±5	90±5	120±5	1
MS145DS/D	13±4 / 20±4	106±6	140±5	1
MS2002	25±10	115±5	160±5	2
MS4002	10~43*	123±8	176±8	2, 4
MS4004	10~43*	120±10	170±10	4
MS4600	25±5	123±8	181±5	5
MS4600X	22±4	125±5	170±5	5
MS4600FSS	7±3	138±5	160±5	2, 4
MS4600F	40±5	115±5	180±5	3, 5
MS4702F	32±5	115±5	180±5	3
MS180DY	30±5	139±5	183±5	3, 7
MS190D	30±5	160±5	194±4	3
MS197D	24±4	169±3	193±3	3
MS200	30±4	140±5	200±5	3
MS3001	34±6	161±5	214±6	7

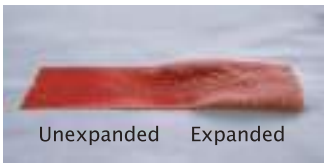
* APS (Average Particle Size) can be selectable

Wet type

Item	Specification				Application
	APS(㎛)	Ts(℃)	Tmax(℃)	Moisture(%)	No.
MS140WS/W	15±5 / 25±5	90±5	120±5	20±1	1
MS145WS/W	13±4 / 20±4	106±6	140±5	20±1	1
MS3000A	53±4	192±5	210±5	20±1	6

Applications

1. Acryl Binder for textile

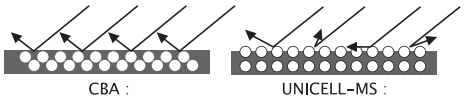


2. PVC Wallpapers, Floorings

3. Shoe-sole of PVC, TPR, EVA

Fine isolated cell
Excellent shape stability
Embossed surface

Reduced weight
Elegant mat surface
Fine cell
Stable foam
Good resilience



CBA :
Chemical blowing agents

UNICELL-MS :
Expandable microspheres

Chemical foaming agent

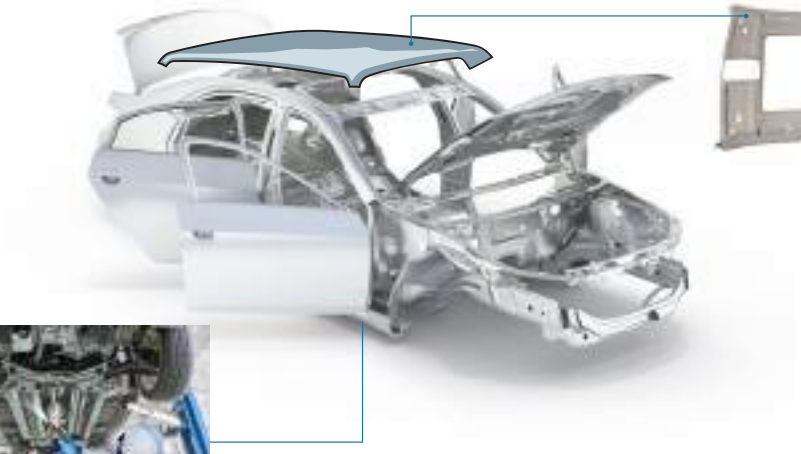
UNICELL-MS

4. PU Coatings

5. Underbody Coatings

6. PP/GF reinforcement materials

Headliners



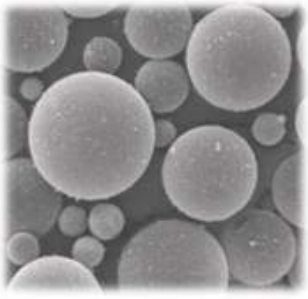
7. Others : Mat, Floorings, Cushion tape ETC.

UNICELL-HMS Series

Description

UNICELL-HMS is hollow microspheres.
It is an expanded type of UNICELL-MS.
These products can be used as ultra light fillers.

Structure



Feature

- Extremely low density, 0.017~0.045g/㎤
- Exellent elasticity
- Exellent Solvent resistance
- Exellent sandability

Products

Item	Specifications	
	APS(㎛)	Density(kg/㎥)
HMS A grade	**Softening point : 120℃**	
A20D/A50D/A100D	15~150	17~45
HMS B grade	**Softening point : 100℃**	
B50D/B100D	15~150	17~45
HMS C grade	**Coated hollow microsphere**	
C20D/C50D/C100D	15~150	75~165

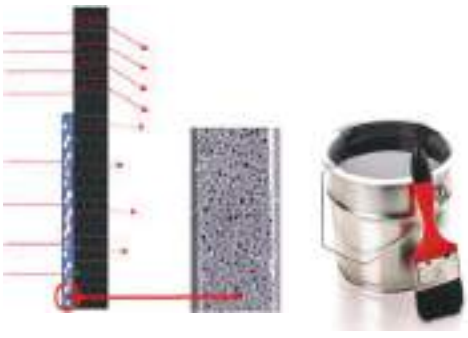
· We have wet type of product. (with 15% Solid content)

Applications

Toy Clay

Auxiliaries for Natural leather

Insulation Paint



Car repairing

Cable Filler

Sensitizer of emulsion explosives

UNIBEAD-Series

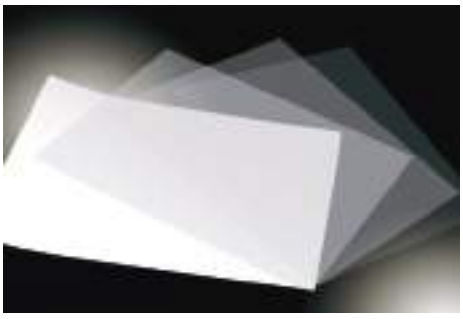
Description

UNIBEAD Series is a fine spherical polymeric bead and composed of crosslinked Polymethyl methacrylate (PMMA), Polybutyl methacrylate (PBMA), Polystyrene (PS) etc.
UNIBEAD diffuses a light with resins and those sheets or films have an effect of diffusion. In case of inks or paints, **UNIBEAD** can give functions of anti-scratch, lusterless effect. Using cosmetics like emulsion lotions including **UNIBEAD**, customer must feel softness and wrinkle-free.

Applications

Display

- Diffusion film
- Anti-Glare film



UNIBEAD-DBM, UNIBEAD-DBPH

Lighting

- LED Light cover

UNIBEAD-DBPH, UNIBEAD-PT

Paint/Ink

- Anti-Scratch material
- Anti-Gloss material

UNIBEAD-DBPH

Cosmetics

- Soft focus
- Oil absorbency

UNIBEAD-DBPC

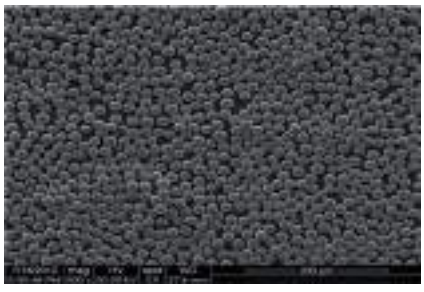
Products

GRADE	Particle Size(㎛) Mean Diameters : D 50	Heat / solvent Resistrant	Refractive Index	Particle Distribution
DBPH	7 / 15 / 20 / 25	High	1.49	Poly Dispersion
DBSM	10 / 15 / 20	High	1.49	Semi-mono Dispersion
DBPB	7 / 15 / 20 / 25	High	1.49	Poly Dispersion
DBPS	7 / 15 / 20 / 25	High	1.59	Poly Dispersion

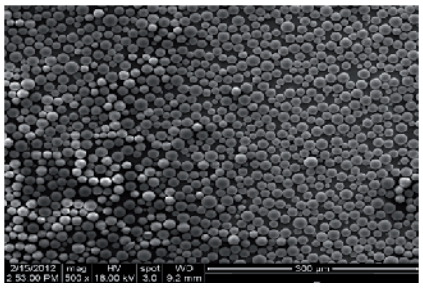
Composition

- Cross-linked Polymethylmethacylate : UNIBEAD-DBSM , DBPH
- Cross-linked Polybutylmethacrylate : UNIBEAD-DBPB
- Cross-linked Polystyrene : UNIBEAD-DBPS

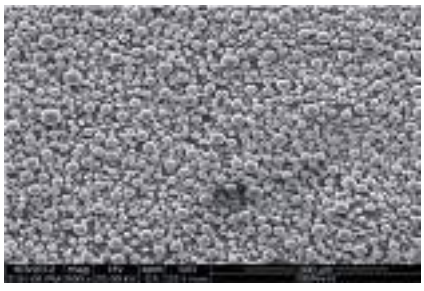
UNBEAD-DBM15



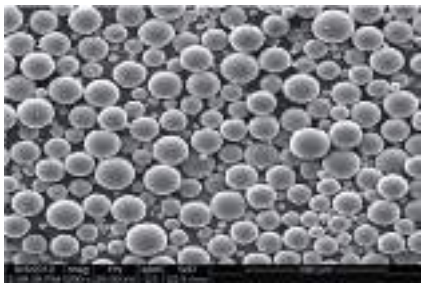
UNIBEAD-DBSM15



UNIBEAD-DBPH15



UNBEAD-DBPB40



Even though not listed above, we can offer a suitable product by our own technology. Please contact our technicians.

CASTING

PVC Wall Covering (1)

PVC resin (p=1000)	100
Filler	100
Plasticizer	80
Stabilizer (Ba-Zn)	3
Process Oil	7
UNICELL-OH	4

Gelling Condition 145℃ × 50sec.
Foaming Condition 260℃ × 15sec.
Thickness of sheet 0.2mm

PVC Wall Covering (2)

PVC resin (p=1000)	100
Filler	30 ~ 40
Plasticizer	50
Stabilizer (Ba-Zn)	3
TCP	30
Sb_2O_2	10 ~ 20
TiO_2	10
ZnO	1 ~ 2
UNICELL-DWT	3

Gelling Condition 150℃ × 50sec.
Foaming Condition 230℃ × (30~60)sec.
Thickness of sheet 0.2mm

PVC Flooring Material (1)

Foam Layer	
PVC resin (p=1300)	50
PVC resin (p=800)	50
Filler	20
Plasticizer	70
Stabilizer(Ba-Zn)	3
TiO_2	3
ZnO	1
UNICELL-DE3 / T200L	3.4 / 2 ~ 2.5

Skin Layer	
PVC resin (p=1700)	100
Plasticizer	55
Stabilizer (Ba-Zn)	3

Foam layer Gelling Condition (150~160℃) × 30sec.
Skin layer Gelling Condition (150~160℃) × 50sec.
Foaming Condition 210℃ × 80sec.

PVC Flooring Material (2)

Foam Layer	
PVC resin (p=1000)	100
Filler	20
Plasticizer	60 ~ 70
Stabilizer (Ba-Zn)	1.5
Dispersant	0.2
TiO_2	3
ZnO	1.6
UNICELL-D300L	2.5

Skin Layer	
PVC resin (p=1700)	100
PVC resin (p=1000)	35
Plasticizer	60 ~ 65
Stabilizer (Ba-Zn)	2.5
UV absorption	0.3

Foam layer Gelling Condition (150 ~ 160℃) × 30sec.
Skin layer Gelling Condition (150 ~ 160℃) × 50sec.
Foaming Condition 200℃ × 90sec.
Foam layer Thickness 0.3mm
Skin layer Thickness 0.2mm

PVC Flooring Material (3)

PVC	100
Plasticizer	60
Stabilizer (Ba-Zn)	3
$CaCO_3$	50
UNICELL-DL31	4

PVC Artificial Leather (1) : no-embossing

PVC resin (p=1700)	64
PVC resin (p=1100)	16
PVC Blend resin (C-65V)	20
Filler	20
Plasticizer	50 ~ 65
TXIB	5
Stabilizer (Ba-Za)	5
Pigment	3 ~ 5
UNICELL-D1100	3.5

Gelling Condition 160℃
Foaming Condition 250℃
Thickness of sheet 0.12 ~ 0.2mm

PVC Artificial Leather (2) : embossing

PVC resin (p=1700)	80
PVC Blend resin (C-65V)	20
Filler	20
Plasticizer	60 ~ 80
TXIB	3
Stabilizer (Ba-Za)	3
Pigment	3 ~ 5
ESO	5
UNICELL-DX77N	3.5 ~ 4.5

Gelling Condition 150℃
Foaming Condition 240℃
Thickness of sheet 0.14 ~ 0.4mm

CALENDERING

PVC Artificial Leather(1)

PVC resin (suspension, p=1000)	100
Filler	10
Plasticizer	60
Stabilizer (Ba-Zn)	3
Stearic Acid	0.5
UNICELL-T80	4.5

Calendring Condition 155 ~ 165℃
Foaming Condition 200 ~ 230℃, 1 ~ 3min.

PVC Artificial Leather(2)

Usage / Ingredient	Artificial Leather		Car Mat
	For Clothing	For Packaging	
PVC resin (suspension, p=1100)	100	100	100
Plasticizer I	90	50	50
Plasticizer II	15	10	5
Plasticizer III	10	0	0
ESO	5	5	0
Stabilizer (Ba-Zn)	2.5	2.5	2.5
$CaCO_3$	5	20	10
UNICELL-D600/D900/D1100	4	3	5

Compounding Condition 140 ~ 155℃
Calendering Condition 155 ~ 165℃
Foaming Condition 200 ~ 230℃, 1 ~ 3min.

INJECTION MOLDING

PVC Injection Mold Foam (1) : sandal

PVC resin (p=1000)	90 ~ 95
EVA resin NBR(A.N. 41%) ABS(hi-flow)	5 ~ 10
Plasticizer	30 ~ 40
Stabilizer	3
UNICELL-D1100	2.5

Barrel Temperature C1: 140℃
C2: 170℃
C3: 170℃
Mold Temperature 30 ~ 40℃

PVC Injection Mold Foam (2) : sandal

PVC resin	100
Filler	as required
Plasticizer	60 ~ 70
Stabilizer	3 ~ 4
UNICELL-D900	2 ~ 3

Barrel Temperature 165 ~ 190℃
Mold Temperature 30 ~ 40℃

PS,ABS/PS Injection Mold foam using UNICELL-C series

PS, ABS/PS	100
UNICELL-C#709/C#850	0.4 ~ 0.7

Process Temperature 200 ~ 240℃

PP,ABS,HDPE,HIPS Injection Mold Foam using UNICELL-TS

PP / ABS / HDPE / HIPS	100
UNICELL-TS	0.8

Compounding 15 ~ 20min. in dry tumble
Barrel Temperature back 193 ~ 199℃
mid 199 ~ 204
front 210 ~ 221
Nozzle Temperature 218 ~ 227
Mold Temperature 16 ~ 38

PRESS MOLDING

PVC & NBR Press Mold Foam (1)

PVC resin (p=1000)	90
NBR	10
Filler	7
Plasticizer	60 ~ 65
Ba-Stearate	5
Ca-Stearate	5
ZnO	2
Stearic acid	1
DCP	0.5 ~ 0.7
UNICELL-DK9	10 ~ 20

Roll Temperature 140℃
Foaming Condition 160℃ × 150kg/cm² × 15min.

PVC Press Mold Foam (2)

PVC resin (p=1000)	100
Filler	20 ~ 30
Plasticizer	50 ~ 60
Ba- Stearate	2
Ca-Stearate	2
DCP	0.5
UNICELL-DK	20

Roll Temperature
Roll Time
Foaming Agent Mixing
DCP Mixing Time
Sheet Thickness
Cooling Temperature
Press Condition

PVC Press Mold Foam (3) : with Plastisol

PVC resin (emulstion, p=1000)	100
Plasticizer	70
Ba-Stearate	2
Ca-Stearate	3
UNICELL-D600	7

1st Heating 172℃ × 10 ~ 20min.
Cooling Condition 25℃ × 5 ~ 20min.

PE Block Foam

LDPE	100
ZnO	0.4
DCP	0.9
D300L	10

Curing Condition 170℃ × 30min.

EVA shoe sole (1)

EVA (VA 25%)	10
EVA (VA 15%)	90
Stearic Acid	1
Filler	5
DCP	0.7
Fluorescent	0.06
TiO_2	3
UNICELL-DX74M	9

Roll Temperature 90 ~ 100℃
Press Condition 160℃ × 35min.
Mold Depth 22mm

EVA shoe sole (2)

Ingredient	Dosage (phr)		
EVA (VA content = 15%)	90	95	90
IR2200	10	5	5
EPDM 301	0	0	5
Stearic Acid	1	1	1
$MgCO_3$	10	5	15
ZnO	2	2	2
TiO_2	2	2	2
DCP	0.7	0.7	0.8
UNICELL-DX74AT/DX74M/DX74 /DX96	3.0 ~ 4.0		

Condition for Curing and Foaming (mold depth : 10mm)

Using UNICELL-DX74AT 150 ~ 155℃ × 150kg/cm² 16 ~ 18min.
Using UNICELL-DX74M 155 ~ 160℃ × 150kg/cm² 16 ~ 18min.
Using UNICELL-DX74 155 ~ 160℃ × 150kg/cm² 18 ~ 20min.
Using UNICELL-DX96 180 ~ 185℃ × 150kg/cm² 16 ~ 18min.

EVA shoe sole (3)

EVA (VA 25%)	40
EVA (VA 15%)	60
Stearic Acid	1
ZnO	2
Fluorescent	0.05
DCP	0.9 ~ 1.0
UNICELL-ADst	5

Roll Temperature 90 ~ 100℃
Press Condition 150℃ × 130kg/cm² × 21min.
Mold Depth 18mm

EVA,Rubber Press Molding Foams

Usage / Ingredient	Beach Sandal			Slipper	Shoe Sole Sports Shoes
	Rubber	EVA	Rubber + EVA		
EVA(VA content=15%)	0	100	75	100	100
Natural Rubber(RSS#3)	40	0	25	0	0
SBR(#1502)	30	0	0	0	0
HSR(Hycar#2057)	30	0	0	0	0
HSR(Hycar#2057)	1	1	1	1	0
Zn-stearate	0	0	0	0	1.2
ZnO	5	0	0	0	0
$CaCO_3$	80	50	0	0	10
$MgCO_3$	0	0	0	25	0
Process Oil	5	0	0	0	0
DCP	0	1	1.1	1	1
Sulfur	2.2	0	0	0	0
UNICELL-AD series	8	6	6	6	7
1st Stage Condition					
Pressure	135	170	164	170	150 ~155
Temperature	150	150	150	150	150 ~180
Time	7 ~ 8	10	10	10	18
2nd Stage Condition					
Pressure	165				
Temperature	50				
Time	68				
Density of Foams	0.3	0.16	0.2	0.18	0.2

EXTRUSION

Rigid PVC Profile

PVC resin (p=1000)	100
TLS	0.6
Filler	10 ~ 20
Plasticizer	2.4
Ba-Stearate	0.8
Ca-Stearate	0.8
Zn-Stearate	0.8
PMMA	0.25
ZnO	0.3
UNICELL-D1100	2

Extruder L/D 25 : 1
Extruder Temperature Feeding 120 ~ 140℃
Melting 150 ~ 160℃
Head 160 ~ 180℃
Die 200 ~ 210℃
Foam Density 0.4 ~ 0.5 g/cm^3

Rigid PVC Foam

PVC resin (p=1000)	100
Processing Aid	2 ~ 3
Impact Modifier	4 ~ 10
Stabilizer	1 ~ 2
Lubricant	1 ~ 3
UNICELL-DW	0.3 ~ 0.5

Extruder L/D 24 : 1
Extruder Temperature Feeding 170℃
Melting 180℃
Head 182℃
Die 175℃

Chemically Crosslinked PE Sheet (High Expansion Foam)

LDPE	100	90
EVA		10
DCP	0.7 ~ 1.0	0.7 ~ 1.0
UNICELL-D1500PE	15 ~ 23	15 ~ 23

Roll Temperature 110 ~ 120℃
Extruder Temperature 110 ~ 120℃
Foaming Temperature 130 ~ 230℃

Electron Beam Crosslinked PE Sheet (High Expansion Foam)

LDPE	100
Ba-Stearate	0.3
Zn-Stearate	0.3
UNICELL-D1500CS	21

Roll Temperature 110 ~ 120℃
Extruder Temperature 110 ~ 120℃
Foaming Temperature 130 ~ 230℃

No-crosslinked LDPE Extruded Foam

LDPE	100
TiO_2	0.15
UNICELL-C#850	0.20
UNICELL-C#709	0.80

Extruder Temperature Feeding 160℃

Extruded Foam (Profile and Pipe)

Ingredient \ Usage	Sheet Profile	Sheet Pipe	Sheet Pipe	Sheet Profile	Sheet Profile
PVC(suspension)	100				
LDPE		100			
PP			100		
PS				100	
ABS					100
Crosslinking agent		0.7~1.0			
Stabilizer(Ba/Zn)	3~5				
Processing Aid	5~10	0~1	0~1	0~1	0~1
Plasticizer	0~60				
UNICELL-D300/400/600	0.5			0.5	0.5
UNICELL-D800/D100/D1500		0.5	0.5		
Barrel Temperature Zone 1	150℃	150℃	160℃	150℃	150℃
Barrel Temperature Zone 2	160℃	170℃	170℃	160℃	160℃
Barrel Temperature Zone 3	170℃	190℃	190℃	170℃	170℃
Barrel Temperature Zone 4	180℃	200℃	200℃	180℃	180℃
Barrel Temperature Header	180℃	190℃	200℃	180℃	180℃
Barrel Temperature Die	160℃	170℃	180℃	160℃	160℃
Revolution of Screw	40rpm	50rpm	40rpm	40rpm	40rpm
Compression Rate	3.5 : 1	3.0 : 1	2.5 : 1	2.5 : 1	2.5 : 1

PP, PS, ABS, PE, PVC Extruded Foam (UNICELL-C series)

Roll of UNICELL-C series	Foaming Agent		Nucleating Agent	
Resin	PP, PS, ABS, PE, PVC		PS, PE, PVC	
Foamed Material	Sheet	Film	Sheet	Film
UNICELL-C#709/C#850	0.5~0.7	0.4~0.6	0.4~0.6	0.3~0.5
Processing Temperature(℃)	190~220	190~220	210 max.	

PP,PS,ABS,HDPE,HIPS Extruded Mold Foam (UNICELL-TS)

PP / ABS / HDPE / HIPS	100
UNICELL-TS	0.2~0.5

Compounding

Barrel Temperature	back	15~20min. in dry tumble
	mid.1	177~182℃
	mid.2	188~193℃
	front	199~204℃
Die Temperature		216~221℃
Screw Speed		202~204℃
		25~100rpm

RUBBER APPLICATIONS

NR,SBR Sponge (1)

NR	30	65
SBR	47	15
NBR	23	20
Peptizer	0.3	-
Petroleum Resin	10	-
Sulfur	2	-
T-AZO	5	2.5
Stearic Acid	2	1.5
Wax	1	-
Silica	33.3	-
Filler	56.7	60
DEG	3.3	-
TiO_2	15.7	-
ZnO	-	6
Scrap	-	80
Clay	-	40
DM	1.1	1
M	0.1	-
UNICELL-G	6.5	6
UNIPASTE	6.2	-

1st curing 141~144℃ × 5~7min.
2nd curing 158~164℃ × 6~8min.

NR,SBR Sponge (2)

Ingredient \ Usage	Soft Sponge	Semi-rigid Sponge	Rigid Sponge
Natural Rubber(RSS#3)	60	30	30
SBR(#1502)	40	30	20
HSR(Hycar#2057)	0	40	50
Sulfur	2.5	2.5	2.5
ZnO	5	5	5
Stearic Acid	2	1.5	1.5
MBTS	0.6	1	1
Processing Aid	6	5	5
Hard Clay	0	30	30
$CaCO_3$	120	90	120
TiO_2	5	5	5
UNICELL-G Series	7	5	4
UNIPASTE	6	6	4
Condition			
1st Stage	semi-vulcanized foaming stage		
Pressure	100~150kg/cm^2		
2nd Stage	totally vulcanized foaming stage		
Pressure	30~50kg/cm^2		
3rd Stage	aging for the weatherability		
Temperature & Time	60~80℃, 24hrs.		

NR, SBR Sponge (1)

Ingredient \ Usage	Rigid Sponge	Semi-rigid Sponge
Natural Rubber (RSS#3)	25	30
SBR (#1502)	20	30
HSR (Hycar#2057)	55	55
Sulfur	2.5	2.2
ZnO	5	5
Stearic Acid	1.5	1.5
MBTS	0.8	1.2
TMTD	0.1	0
CBS	0	0.5
Processing Aid	5	50
$CaCO_3$	70	90
Hard Clay	30	50
White Carbon	25	10
Process Oil	10	10
UNICELL-AD Series	9	13.5
Condition		
1st Stage		
Pressure	150	150
Temperature	141	138
Time	6~8	8~10
2nd Stage		
Pressure	50	50
Temperature	158	158
Time	7~9	6~8
Density of Foams	0.35~0.40	0.26

SBR Sponge

SBR	80
Silica	15
Process oil	15
ZnO	5
Carbon	5
Stearic Acid	2
Sulfur	2
MBTS	0.3
TMTD	0.1
UNICELL-DK series	6

Press Condition 155 ~ 165℃
150kg/cm²
15 ~ 20min.

NBR, PVC Foam

Ingredient \ Usage	Pipe Insulation	Floating
NBR(medium A.N.)	70	50
PVC(suspension resin)	30	50
Silica	30	60
Talc	35	20
$CaCO_3$	15	0
Carbon Black	3	0
Tricresyl Phosphote	60	60
Chlorinated Paraffin	10	10
Antioxidants	1	1
Stabilizer(Ba+Zn)	1	1
Dibosic lead Phosphite	1	0
ZnO	3	3
Stearic acid	1.5	1.5
PEG	3	3
UNICELL-OH	1.5	20
Accelerator	2	0
DTH	0	1
Sulfur	3	2

Extrusion Condition Barrel temperature 65℃
Head and Die temperature 75℃
Cure Condition 140℃, 15min.

DTH : **D**ipentamethylene **T**hiuram **H**exasulfide

CR Sponge (1)

CR	100
MgO	4
BLE	1.5
Wax	3
ZnO	1
Guanidine	0.75
LPO	30
Filler	50
UNICELL-OH	7.5

Press Condition 145℃, 15~17min.

CR Sponge (2)

CR(PM-40)	65
CR(M-40)	65
Clay	20
Black factice	20
Processing Oil	33
ZnO	15
MgO	5
Diphenyl guanidine	1.3
Ethylene thiourea	0.7
UNICELL-DK series	2
UNIPASTE-PII	1

Press Condition 155~165℃
100kg/cm^2
6~10min.
Aging Condition 160℃
20min.

NBR Sponge

NBR (A.N. 43%)	100
ZnO	5
Stearic Acid	2
HAF	10
Clay	40
Filler	30
Plasticizer	15
DM	0.6
Sulfur	2
UNICELL-G	6
UNIPASTE	6

Press Condition 160 ~ 20min.

RB Foam for out-sole

RB 830	50
IR 2200	20
BR	30
Stearic Acid	1
Silica	10
TiO_2	5
Polyethylene Glycol	2
BHT	1
DCP	0.4
UNICELL-D	1.5
UNICELL-G	1.5
UNIPASTE	3

Milling Condition(Banbury mixer) 70 ~ 130℃, 5min.
Rolling Temperature 80℃
Press Temperature(mold : 6 × 180 × 220mm) 150 ~ 165℃, 7 ~ 9min.
Post Cure Condition 70℃, 4hrs.

EPDM Sponge (1)

EPDM	100	100
MT	150	-
Tale	-	100
Clay	-	95
Parafin Oil	100	125
ZnO	5	5
St-Acid	5	5
Sulfur	1.5	1.5
TT	1.5	1.5
M	0.5	0.5
UNICELL-OH	15	15

Curing Condition 165℃ × 20min.

EPDM Weatherstrips

Master Batch	
EPDM (Royalene 525)	100
Clay	35
SL-90 Black	40
N-550 FEF Black	35
$CaCO_3$	50
ZnO	4
Stearic Acid	1
Napthenic oil	60
UNICELL-OHW2	8

Dosage sequence ingredient ⟶ EPDM
Banbury Condition 5 ~ 6min. up to 132℃

Sheet	
Master Batch	333
UNICELL-OH	1
MBT	2
BUTAZATE	2
Sulfads	2
Sulfur	2

Dosage sequence 1/2 MB ⟶ ingredient ⟶ 1/2 MB
Banbury Condition 2 ~ 3 min. up to 82℃
Curing Condition
Precure 154℃, 3min.
Expansion 200℃, 3min.

BUTAZATE : Zinc Dibutyldithiocarbamate
Sulfads : Diphentamethylene Thiuram Tetrasulfide

WORLD WIDE NETWORK

DONGJIN SEMICHEM

1. Seoul Office (Head Office / Sales div.)
402, World Cup buk-ro, Mapo-gu, Seoul, Korea
TEL: +82-2-325-9451~8 FAX: +82-2-338-3935
e-mail: trade@dongjin.com

2. Shiwha Plant (Foaming Agent Div./TSP Div.)
16, Somanggongwon-ro, Siheung-si, Gyeonggi-do, Korea
TEL: +82-31-319-0011~6 FAX: +82-31-319-0017
e-mail: joyy@dongjin.com

3. Busan Office (Domestic Sales Div.)
18, Gwangbok-ro 97beon-gil, Jung-gu, Busan, Korea
TEL: +82-51-246-8494,6530 FAX: +82-51-255-3978
e-mail: djbusan@dongjin.com

4. Pangyo R&D Center
35, Pangyo-ro 255beon-gil, Bundang-gu, Seongnam-si,
Gyeonggi-do, Korea
TEL: +82-31-620-7700 FAX: +82-31-696-4900

OVERSEAS AFFILIATED COMPANY

1. Indonesia Office (Jakarta)
ADD: Intercon Plaza, Blok C-16,Taman Kebon Jeruk, Jakarta Indonesia
TEL: +62-21-584-3435,3334,3377,5588 FAX: +62-21-584-1853

2. Indonesia Plant (Cilegon)
ADD: Jl Raya Anyer Km 123 Ciwandan-Cilegon-Banten
TEL: +254-601245,601246,601023 FAX: +254-601247

3. Ningxia Plant
ADD: 43 Gangdian South road, Hebin Industrial Zone, Shizuishan City,
Ningxia Province, China
e-mail: trade@dongjin.com

4. Dongjin USA, Inc.
ADD: 2010 Bigler Street, Fort Lee, NJ 07024
TEL: +201-944-0945,0946 FAX: +201-944-0947

5. UNICELL CO. LTD.
ADD: NO.13-17 Nakainoue Cho Higashino Yamashina Kyoto Japan
TEL: +001-81-75-595-9439

EXPORT & IMPORT DIV.

ADD: 23rd fl., 402, World Cup buk-ro, Mapo-gu, Seoul, Korea
TEL: +82-2-325-9451~8
FAX: +82-2-338-3935
e-mail: trade@dongjin.com

HOME PAGE : http://www.dongjin.com

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