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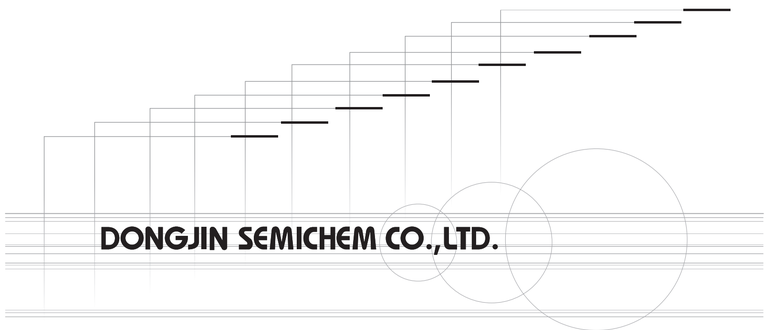
MAY. 2015

# UNICELL

## FOAMING AGENTS

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DONGJIN SEMICHEM CO.,LTD.

# UNICELL

FOAMING AGENTS

DONGJIN SEMICHEM CO.,LTD.

## Contents




DONGJIN SEMICHEM CO.,LTD.

## 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 advanced technologies and the cultivation 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 Dongjin Semichem Co., Ltd's brand name.
It represents outstanding quality foaming agents and activators designed for the plastics and rubber industry.

There are two product classifications:
· Foaming Agents (CFA's) both chemical and physical
· and Activators

CFA's generate gases in a polymer melt that create bubbles, thus producing a cellular structure through a decomposition mechanism.
These CFA's are divided into two types: organic and inorganic and include:
· UNICELL D / AD / OH / H / BSH / G / TS / C and etc.
Physical foaming agents generate a cellular structure by undergoing a phase transition.
· 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, unobjectionable odor, and relatively harmless to the human body 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 |
| DL Series | Modified ADCA | Fine yellow powder | 140~145 | 140~190 | 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 Wallpaper |
| AD Series | Modified DNPT | 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 |
| Master Batch Products | Foaming agent Master batch | Yellow or White pellet | | | EVA, SHOES, PS, PP, PE, ABS |
| 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 | |
| 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 Assuranced Dept. have wide technical experiences, and are always ready to provide 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 Overseas Sales Dept.

Emergency Call : +82-2-6355-6100

Emergency Fax : +82-2-338-3935

E-mail : trade@dongjin.com



**UNICELL SERIES**

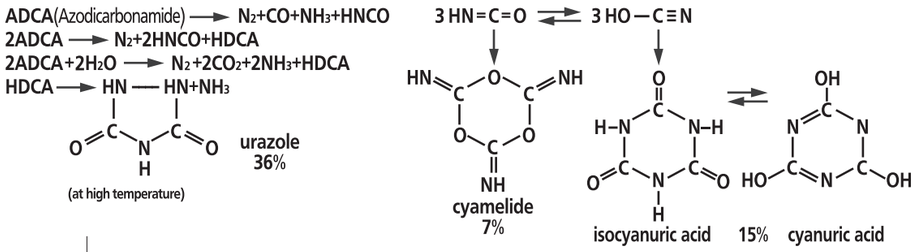
DONGJIN SEMICHEM

# 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 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

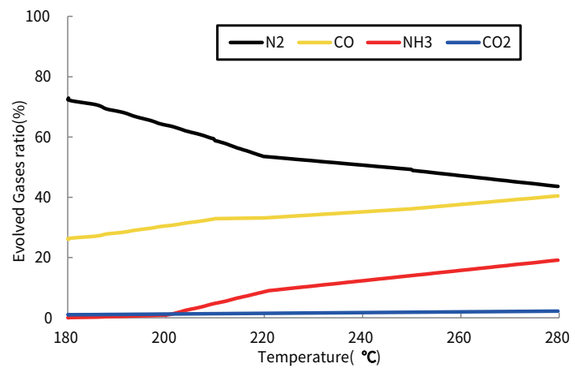
Decomposition mechanism of **UNICELL-D** series (ADCA) is complex and depends on the heating range and the process condition.




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 |






# Properties of UNICELL-D series

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

| Item | | Specification | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Grade Name | | D200A | D300 | D400 | D600 | D800 | D900 | D1100 | D1500 |
| 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 | 5.6~6.1 | 6.2~7.2 | 8.2~9.0 | 10.8~11.8 | 12.0~13.0 | 14.0~15.0 | 19.0~21.0 |
| | Fisher | 2.5~2.8 | 2.6~2.9 | 3.6~3.9 | 5.7~6.1 | 7.6~8.0 | 8.0~8.3 | 9.6~10.0 | 14.0~17.0 |
| 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<br>DMSO 4.300<br>MEK 0.015<br>Acetone 0.016<br>DMF 5.000<br>Toluene 0.012<br>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 the 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.

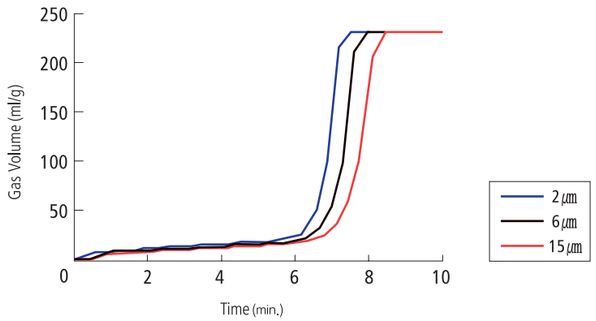
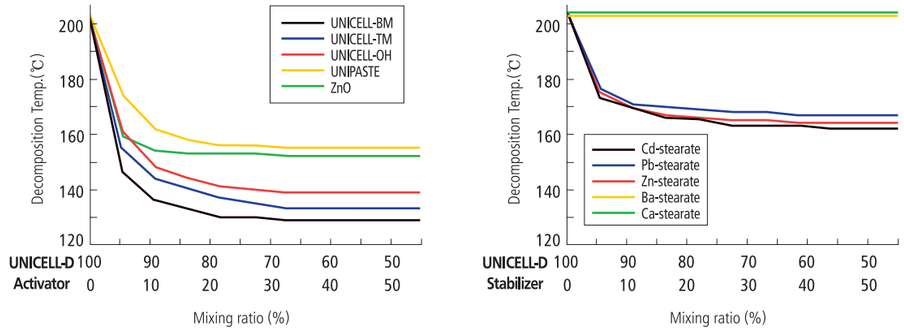



Fig 2. The decomposition behavior of **UNICELL-D** series at the constant temperature of 200℃

# 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 inhaled, 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 inhale.
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 oral 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 exceeding 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

• Modified Azodicarbonamide (Azobisfomamide)
• Foaming Agents for Injection Molding and Extrusion System

Dongjin Semichem Co., Ltd.

## 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 in 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 & DK Series

• Modified Azodicarbonamide (Azobisfomamide)
• Specially designed foaming agents for cellular plastics and rubbers

Dongjin Semichem Co., Ltd.

## Description

**UNICELL-DL** series is an Azodicarbonamide-based blowing agent with the fastest decomposition rate, making it suitable for processes such as PVC casting.
**UNICELL-DK** series is an excellent product with high whiteness, making it suitable for EVA and Rubber processes.

## Properties of UNICELL-DL & DK series

| Item | Specification | | | | |
|---|---|---|---|---|---|
| Grade Name | DL31 | DL75N | DL04 | 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 | 135~140 | 160~165 | 163~168 |
| Gas Volume (ml/g, at 25℃) | 145~165 | 170~190 | 135~155 | 170~190 | 175~195 |
| Average Particle Size (㎛) | 2.6~3.0 | 3.5~4.0 | 2.6~3.0 | 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 | PVC Plastisol | | | Rubber Molding | |

## Applications

When using **UNICELL DL & DK** series, process temperature may need to be lowered to avoid premature decomposition during compounding process.

# UNICELL-DX & DU Series

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

Dongjin Semichem Co., Ltd.

## Description

**UNICELL-DX & DU** series have 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.

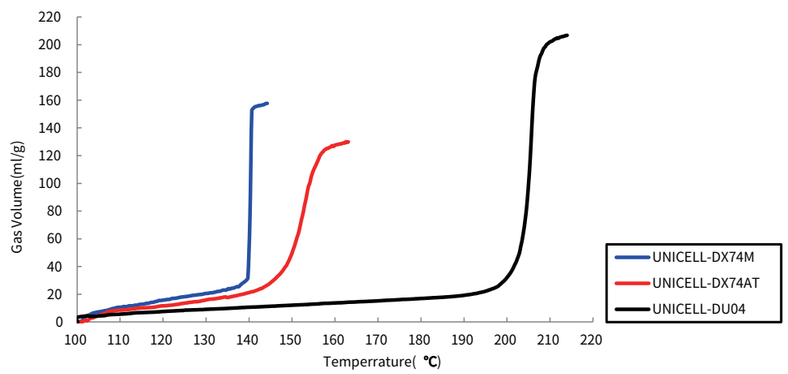
## Properties of UNICELL-DX & DU series

| 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 are particularly suited for shoe soles, and the other grades are usually used for EVA or Rubber press molding and PVC extrusion systems.






# UNICELL-D1500 Series

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

Dongjin Semichem Co., Ltd.

## 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 easily dispersed 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 | DT08M | 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 | 195~199 | 197~203 |
| Gas Volume (ml/g, at 25℃) | 200~220 | 220~240 | 220~240 | 195~215 | 225~245 |
| Average Particle Size (㎛) | *11.5~15.5 | *11.5~15.5 | *14.0~17.0 | *11.0~15.0 | *17.0~21.0 |
| Moisture Contentor Heat Loss (%) | 0.6 max. | 1.3 max. | 0.5 max. | 1.5 max. | 0.8 max. |

* Measured by Laser Particle Sizer

## Applications

General applications of polyethylene foams with **UNICELL-D1500** series are ;
- Thermal insulations
- Floating devices
- 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 | 202~208 | 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
- Floating devices
- Packaging materials
- Sports and leisure goods
- Life jackets
- Electron beam radiation crosslinking foams



# UNICELL-Master Batch Products

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



## Description

**UNICELL-Master Batch Products** have been developed specially as MASTER-BATCH of foaming agent for the expansion of EVA/LDPE resin.
**UNICELL-Master Batch Products** consist of EVA/LDPE resin and foaming agent

The following advantages are obtained by using **UNICELL-Master Batch Products** for the expansion of EVA/LDPE resin.
-Prevents scattering of the foaming agent
-Reduces mixing time with base resin
-Provides excellent storage stability
-Reduces fire and explosion risks
-Prevents physical property reduction of the foamed part
-Provides whiter and more uniform cell structure

## Properties of UNICELL-Master Batch Products for EVA

| Item | DX74MT | DX74HPMB | D600MT | DX3MT | DX19MT |
|---|---|---|---|---|---|
| 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 | 148~154 |
| Gas Volume (ml/g) | 75~85 | 85~95 | 125~135 | 95~105 | 90~100 |
| Contents of Foaming Agent (%) | 55 | 55 | 50 | 55 | 60 |
| VA Contents of EVA (%) | 21 | | | 22 | |

## Properties of UNICELL-Master Batch Products for LDPE

| Item | D800LP65 | C#850MT | C#709MT |
|---|---|---|---|
| Appearance | Yellow pellet | White pellet | White pellet |
| Decomposition Temperature (℃) | 205 ~ 209 | 150 ~ 220 | 155 ~ 165 |
| Gas Volume (ml/g) | 150 ~ 160 | 35 ~ 45 | 45 ~ 50 |
| Contents of Foaming Agent (%) | 65 | 33 | 33 |
| Carrier Resin | LDPE | LDPE | LDPE |

## 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 PS, PP, PE, ABS, TPR, TPE etc.

# UNICELL-AD Series

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

Dongjin Semichem Co., Ltd.

## Description

**UNICELL-AD** series is broadly used as 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 N,N'-Dinitrosopentamethylene tetramine | | | | |
| 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 an economical foaming agent broadly used for thermoplastics and rubber.
**UNICELL AD** series is applied in low temperature processes.

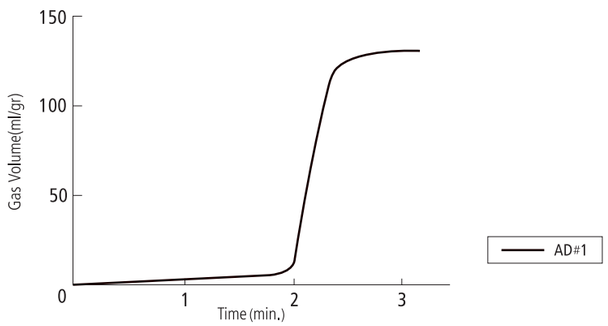



Fig. Decomposition behavior of **UNICELL-AD** series at the constant temperature of 160℃



# UNICELL-DWP Series

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

Dongjin Semichem Co., Ltd.

## Description

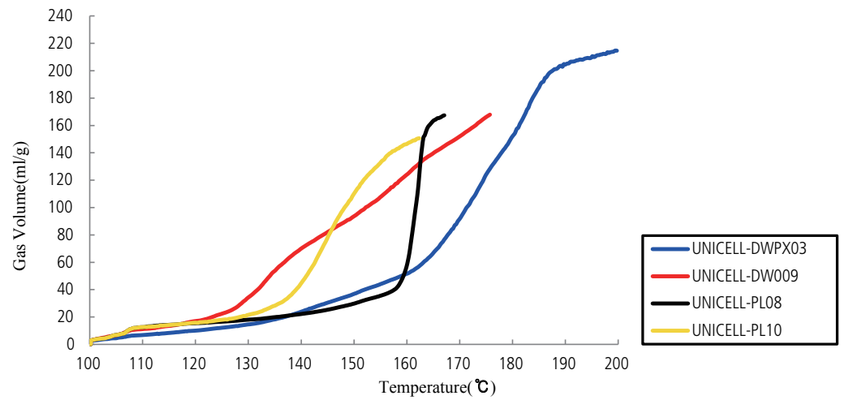
**UNICELL-DWP** series has been designed specially to be used in expanded PVC wall coverings. Along with the advantages of solid vinyl wall coverings, they provide the following advantages:
- Design in depth
- Increasing thermal insulation
- Reduction in weight with consequent saving of raw materials
- Providing whiter foams

## Properties of UNICELL- DWP series

| Item | Specification | | | | | |
|---|---|---|---|---|---|---|
| Grade Name | DWPX03 | PL07 | PL08 | PL10 | DW007 | DW009 |
| Chemical Name | Modified Azodicarbonamide | | | | | |
| Chemical Formula | $H_2N-CO-N=N-CO-NH_2$ | | | | | |
| Appearance | Fine Yellow Powder | | | | | |
| Decomposition Temperature (℃) | 176~179 | 159~165 | 156~162 | 148~155 | 160~165 | 152~158 |
| Gas Volume (ml/g, at 25℃) | 215~240 | 150~170 | 155~175 | 150~170 | 170~180 | 155~165 |
| Average Particle Size (㎛) | 2.8~3.2 | 2.8~3.2 | 3.0~3.5 | 2.3~2.7 | 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 | | | | | |

## 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.



# 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 | OH160NER |
| 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 | 110~120 |
| Average Particle Size (㎛) | 3.2~4.2 | 2.9~3.3 | 4.0~4.5 | 3.2~4.2 |
| 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<br>Toluence : 0.07<br>Benzene : 0.13<br>MEK : react<br>DNF : react<br>DMSO : very soluble | | | |
| CAS No. | 80 - 51 - 3 | | | |

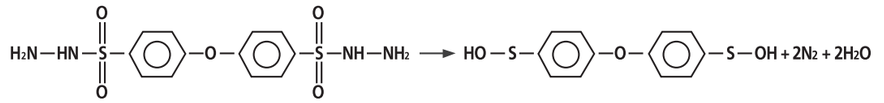


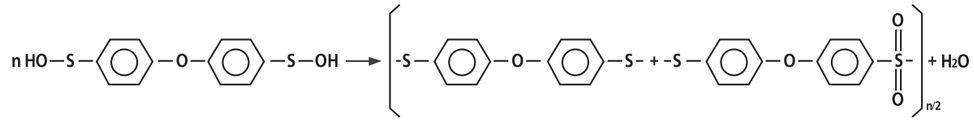
## Applications

**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**.

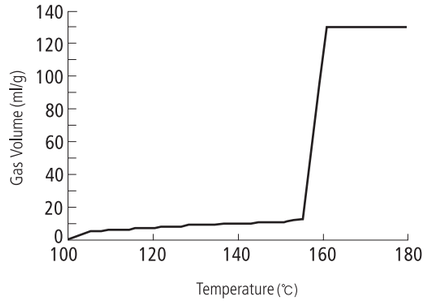



Fig1. The decomposition behavior of **UNICELL-OH** when heating speed is 5℃/min.

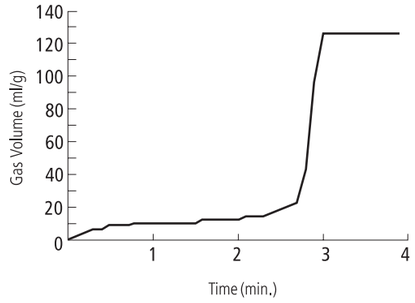



Fig2. The decomposition behavior of UNICELL-OH at the constant temperature of 160℃

# Activation

The decomposition temperature of UNICELL OH can be lowered by different 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-P2 |
| **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 |

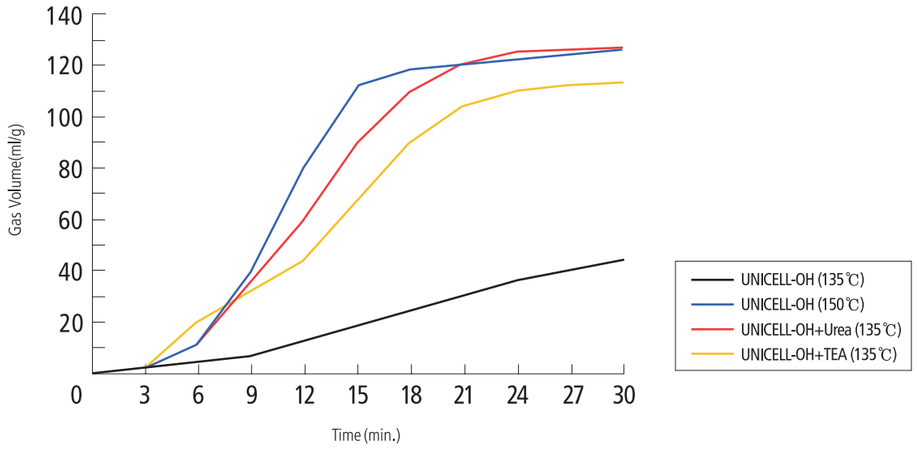



Fig3. The decomposition behavior of **UNICELL-OH** at constant temperature



# Material Safety Data

## Hazards

Overheating may cause fire
Harmful if swallowed
Causes skin irritation
May cause an allergic skin reaction
Causes serious eye irritation
Suspected of causing genetic defects
May cause damage to organs through prolonged or repeated exposure
Very 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 inhaled, 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 inhale.
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 1000~2000 mg/kg Rat
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

## 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.

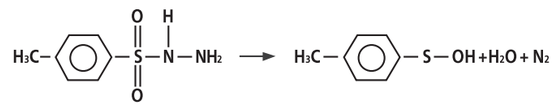
**UNICELL-H** series also has commercial applications for thermosetting polyesters and PVC sealants.

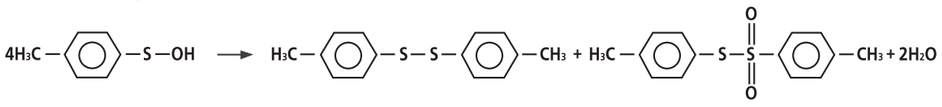
## Properties of UNICELL-H series

| Item | Specification | |
|---|---|---|
| Grade Name | H | H (HC) |
| Chemical Name | p-Toluenesulfonylhydrazide | |
| 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<br>Toluence : 0.35<br>Alcohol : 5.1<br>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

Overheating may cause fire
Toxic if swallowed
Causes skin irritation
May cause an allergic skin reaction
Causes serious eye irritation
(Gas)Toxic if inhaled
Causes damage to organs through prolonged or repeated exposure
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 inhaled, 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 inhale.
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 50~300 mg/kg Rat
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

## Description

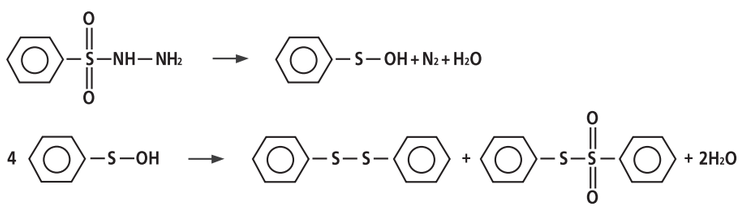
**UNICELL-BSH** series, the trade name of Benzenesulfonylhydrazide, can produce non-discoloring and non-objectionable odor cellular foams. **UNICELL-BSH** series is designed for opened or closed cellular rubbers which have regular and fine cell structure. They have excellent performance without activators 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<br>Toluence : 0.35<br>Alcohol : 5.10<br>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.

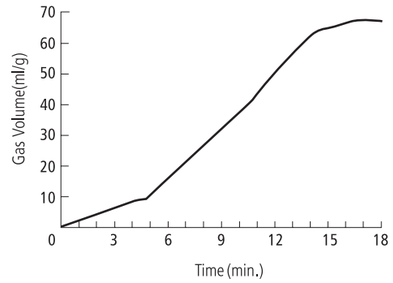



Fig. The decomposition behavior of **UNICELL-BSH** at constant temperature of 150℃

## Material Safety Data

### Hazards

Overheating may cause 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 inhaled, 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 inhale.
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

## Description

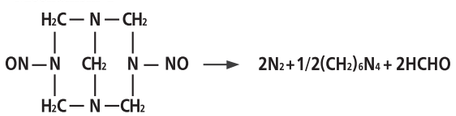
**UNICELL-G** series, the trade name of dinitrosopentamethylenetetramine, is well known as the oldest and most economic foaming agent for plastics and rubbers. And they are non-staining and non-discoloring.
**UNICELL-G** series is usually mixed with oils and inorganic fillers in order to increase the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

## Properties of UNICELL-G series

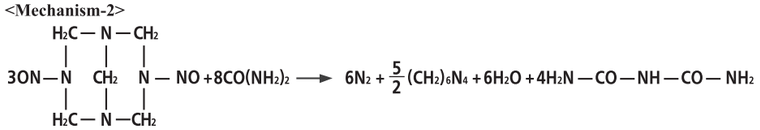
| Item | Specification | | | |
|---|---|---|---|---|
| Grade Name | G (100%) | GP9 | GP3 | GP5 |
| Chemical Name | N,N'-Dinitrosopentamethylene tetramine | | | |
| Appearance | Fine Lemon Yellow Powder | | | |
| Decomposition Temperature (℃) | 197~203 | 197~203 | 197~203 | 202~208 |
| Gas Volume (ml/g, 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<br>MEK : 1.6<br>Alcohol : 0.3<br>Insoluble in almost organic solvents.<br>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 caloric reaction and the unpleasant odor of the residue.

## Material Safety Data

### Hazards

Flammable solid
Overheating may cause fire
Harmful if swallowed
Causes serious eye irritation
(Gas)Harmful 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 inhaled, 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 inhale.
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

## 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<br>Toluene : 0.35<br>Alcohol : 5.10<br>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 : $CH_3-$  $-$

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 inhaled, 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 inhale.
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

## 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.
Most foaming agents are exothermic systems which liberate large amounts of heat during decomposition. Leading to irregular cell structure and local overheating especially in the marginal zones. In contrast, **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.

## 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 produce only carbon dioxide and water vapor, leaving only 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

## 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**.

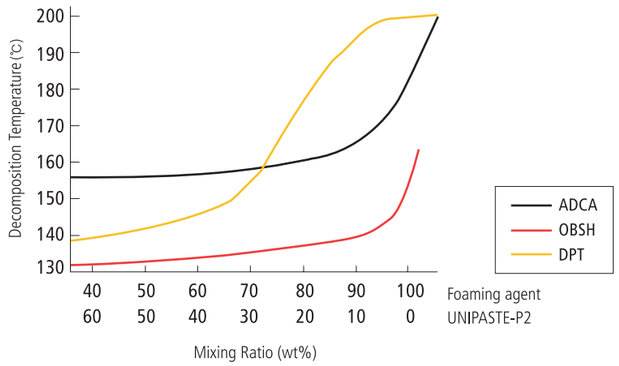



Fig. The activation effects of **UNIPASTE-P2** on **UNICELL-D**, **UNICELL-G** and **UNICELL-OH**

## 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 inhaled, 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 inhale.
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 |

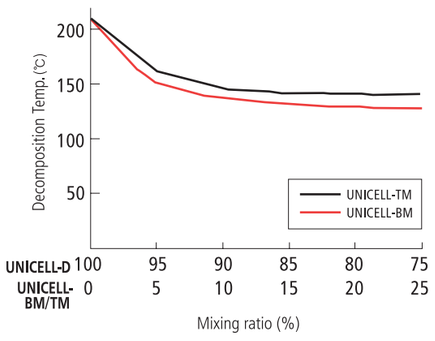



Fig1. The decomposition temperature of **UNICELL-D** mixture with **UNICELL-BM/TM**

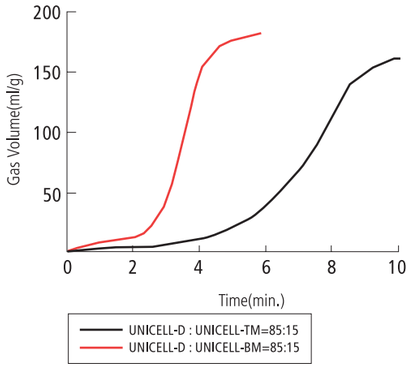



Fig 2. The decomposition behavior of **UNICELL-D** of the constant temperature of 160℃
(mixing ratio.
UNICELL-D: UNICELL-BM/TM=85:15)



## 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.

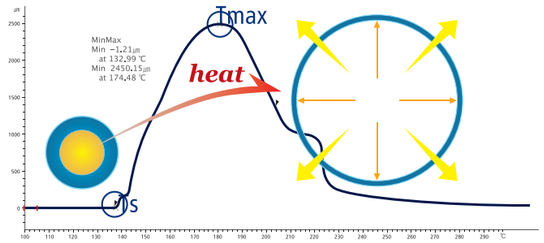
### Other Information
Separate Health and Safety Data Sheets on zinc dibenzene sulfinate and ditoluene sulfinate are available on request.

# UNICELL-MS Series

## Description

**UNICELL-MS** series are thermally expandable microspheres.
They are 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 | 12.5±3.5 / 20±4 | 100±5 | 140±5 | 1 |
| MS2002 | 25±10 | 115±5 | 168±5 | 2 |
| MS4004A | 20±3 | 122.5±7.5 | 167.5±7.5 | 1, 5 |
| MS4600FSS | 7.5±2.5 | 138±5 | 160±5 | 4, 7 |
| MS4600FS | 14.5 ± 3.5 | 130±5 | 170±5 | 2, 4 |
| MS4600X | 22±4 | 125±5 | 170±5 | 5 |
| MS4002 | 13.5±3.5 | 130 ±5 | 173±5 | 2, 4 |
| MS4002A | 20±3 | 122.5±7.5 | 180±5 | 2, 4 |
| MS4600 | 25±5 | 122.5±7.5 | 175±5 | 5 |
| MS4600F | 37±5 | 120±5 | 180±5 | 3, 5 |
| MS4703F | 32±5 | 120±5 | 183±5 | 2 |
| MS4801F | 33±5 | 120±5 | 183±5 | 3 |
| MS190D | 30±5 | 160±5 | 184±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

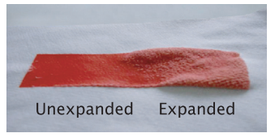
### Wet type

| Item | Specification | | | | Application |
|---|---|---|---|---|---|
| | APS(㎛) | Ts(℃) | Tmax(℃) | Moisture(%) | No. |
| MS140WS / W | 15±5 / 25±5 | 90±5 | 120±5 | 20±1 | 1 |
| MS145WS / W | 12.5±3.5 / 20±4 | 100±5 | 140±5 | 20±1 | 1 |
| MS3000A | 53±4 | 190±7 | 210±5 | 20±1 | 6 |



## Applications

### 1. Acryl Binder for textile

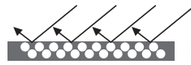



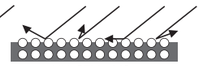

### 2. PVC Wallpapers, Floorings


### 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



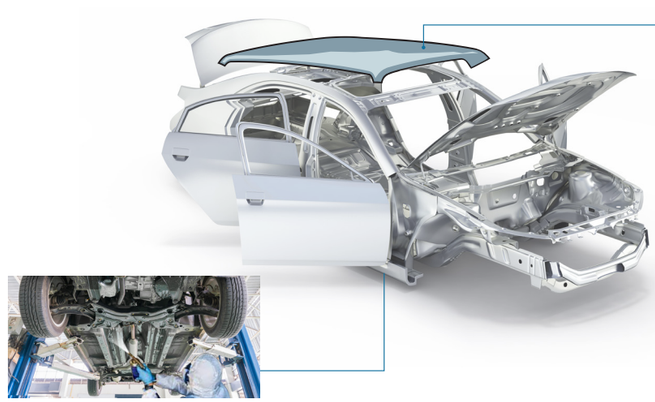



Chemical foaming agent

UNICELL-MS

### 4. PU Coatings

### 5. Underbody Coatings



### 6. PP/GF reinforcement materials

Headliners

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

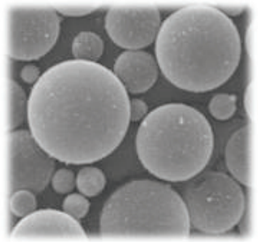
# UNICELL-HMS Series

## Description

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

## Structure





**Feature**

- Extremely low density, 0.017~0.165g/㎤
- Exellent elasticity
- Exellent Solvent resistance
- Exellent sandability

## Products

| Item | Specifications | |
|---|---|---|
| | APS(㎛) | Density(kg/m³) |
| **HMS A grade** | **Softening point : 120℃** | |
| A20D/A50D/A100D | 15~150 | 17~50 |
| **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

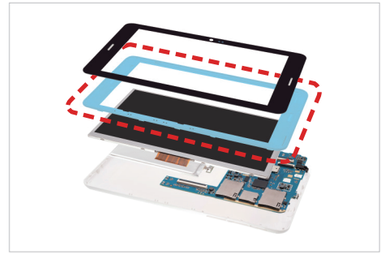
### Insulation Paint

### Car repairing

### Cable filler

### Sensitizer of emulsion explosives

### Window Cushion Tape



# UNIBEAD-Series

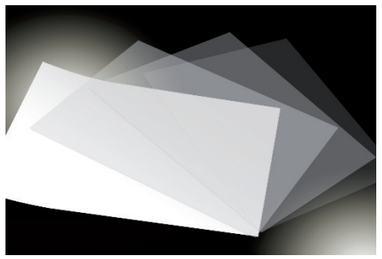
## Description

**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

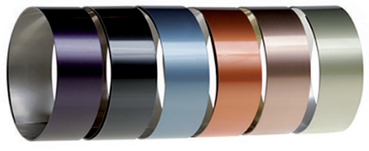
### Lighting

· LED Light cover

UNIBEAD-DBPH, UNIBEAD-PT

### Paint/Ink

· Anti-Scratch material
· Anti-Gloss material



UNIBEAD-DBPH

### Cosmetics

· Soft focus
· Oil absorbency

UNIBEAD-DBPC

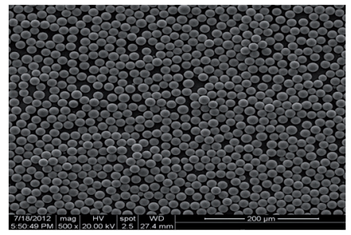


## Products

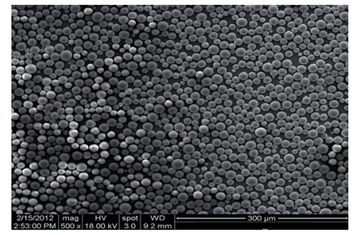
| GRADE | Particle Size(㎛) Mean Diameters : D 50 | Heat / solvent Resistrant | Refractive Index | Particle Distribution |
|---|---|---|---|---|
| DBPH | 7 / 15 / 20 / 25 | High | 1.49 | Poly Dispersion |
| DBSM | 10 / 15 / 20 | High | 1.49 | Semi-mono Dispersion |
| DBPB | 7 / 15 / 20 / 25 | High | 1.49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

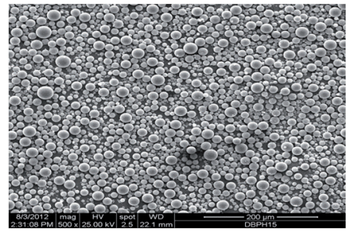
**UNIBEAD-DBM15**




**UNIBEAD-DBSM15**




**UNIBEAD-DBPH15**

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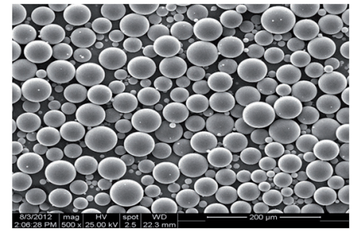



**Even though not listed above, we can offer a suitable product by our own technology. Please contact our technicians.**

# ECO-Friendly Foaming agents

## Description

The combination of **UNICELL-D600LF** (Foaming agent) and **UNICELL-LFP** (Promotor) can reduce formamide emissions below 100 ppm.
(**UNICELL-LFP** is a promotor that is effective when used with **UNICELL-D600LF**.)

Promotor **UNICELL-SLFP** is compatible not only with UNICELL foaming agents but also with other conventional ADCA foaming agents.
It effectively reduces formamide content to below 100 ppm.

For footwear use, **UNICELL-EF115** (Foaming agent) with **UNICELL-EFP1** (Promotor) can reduce formamide emissions below 100 ppm.
(**UNICELL-EFP1** is a promotor which has an effect on the mechanical properties in combination with **UNICELL-EF115**)

**UNICELL-DX19MT** can reduce ammonia emissions by more than 80% compared to conventional foaming agent used for shoe sole. The evolved ammonia gas concentration is less than 20 ppm.

## Properties of Eco-Friendly Foaming Agents

### *Low Formamide Foaming Agents & Promotor*

| Item | Specification | | | |
|---|---|---|---|---|
| | Combination of Foaming Agent and Promotor | | | |
| | D600LF | | LFP | |
| Appearance | Yellow powder | | White powder | |
| Average particle size (㎛) | 5.7 ~ 6.1 | | 4.0 ~ 7.0 | |
| Moisture content (%) | 0.5 max. | | 0.5 max. | |
| Decomposition Temperature (℃) | 196 ~ 202 | | 164 ~ 168* | |
| Evolved Gas Volume (ml/g) | 180 ~ 200 | | 150 ~ 170* | |
| Formamide content analysis result | **FOAMING AGENT** | **D600** | **D600LF** | **D600LF & LFP** |
| | Formamide (ppm) | 1,200 ~ 1,500 | <300 | <100 |

* Decomposition temperature and Gas volume are measured when mixed with UNICELL-D600LF and UNICELL-LFP in the ratio of 5.0 : 2.0.
◈ EVA is foamed by using a compression molding process.

### *Low Formamide Promotor (master batch type)*

| Item | Specification | | |
|---|---|---|---|
| | SLFP | | |
| Appearance | Light blue pellet | | |
| Decomposition Temperature (℃) | 174 ~ 178* | | |
| Evolved Gas Volume (ml/g) | 100 ~ 120* | | |
| Contents of Promotor (%) | 60 | | |
| Carrier Resin | EVA (VA contents 22 %) | | |
| Formamide content analysis result | **FOAMING AGENT** | **D600** | **D600 & SLFP** |
| | Formamide (ppm) | 1,200 ~ 1,500 | <100 |

* Decomposition temperature and Gas volume are measured when mixed with UNICELL-D600MT(or general ADCA) and UNICELL-SLFP in the ratio of 5.0 : 2.0.
◈ EVA is foamed by using a compression molding process.



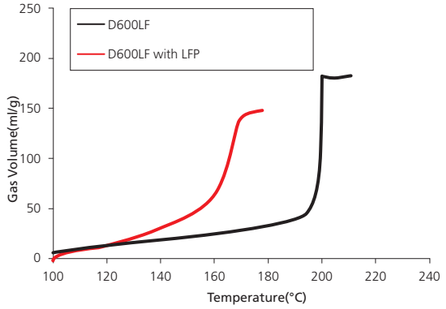



Fig 1. The decomposition temperature of **UNICELL-D600LF** and **UNICELL-D600LF** with **UNICELL-LFP.**

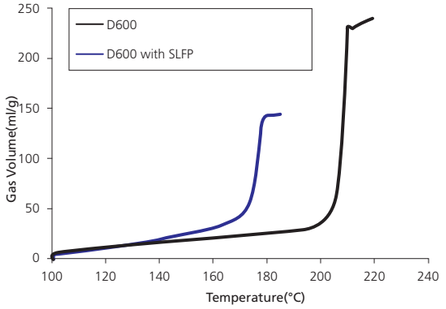



Fig 2. The decomposition temperature of **UNICELL-D600** and **UNICELL-D600** with **UNICELL-SLFP.**

### *Low Formamide, Low Ammonia Foaming Agents & Promotor (master batch type)*

| Item | Combination of Foaming Agent and Promotor | | |
|---|---|---|---|
| | EF115 | | EFP1 |
| Appearance | Yellow pellet | | Light blue pellet |
| Decomposition Temperature (℃) | 156 ~ 160* | | |
| Evolved Gas Volume (ml/g) | 80 ~ 100* | | |
| Contents of Promotor (%) | 60 | | |
| Carrier Resin | EVA (VA contents 22 %) | | |
| Gas content analysis result | **FOAMING AGENT** | **normal ADCA** | **EF115 with EFP1** |
| | Formamide (ppm) | >800 | <100 |
| | Ammonia (ppm) | >500 | <30 |

* Decomposition temperature and Gas volume are measured when mixed with UNICELL-EF115 and UNICELL-EFP1 in the ratio of 5.0 : 2.0.
◈ EVA (slab) is foamed by using an injection molding process.

### *Low Ammonia Foaming Agents*

| Item | Specification |
|---|---|
| | DX19MT |
| Appearance | Pale yellow pellet |
| Decomposition Temperature (℃) | 148 ~ 154 |
| Evolved Gas Volume (ml/g) | 90 ~ 100 |
| Contents of Promotor (%) | 60 |
| Carrier Resin | EVA (VA contents 22 %) |
| Ammonia content analysis result | EVA foam using UNICELL – DX3MT : 200 ppm<br>EVA foam using UNICELL – DX19MT : 20 ppm under<br>*Remarks : in the case of additional use of ZnO, It can increase ammonia evolution. |

## Applications

**UNICELL-LFP** and **UNICELL-SLFP** can be used for general purpose compression molding, **UNICELL-DX19MT**, **UNICELL-EF115** with **UNICELL-EFP1** can be used for injection phylon of EVA or blended EVA with natural/synthesis rubbers, especially in manufacturing mat for fitness and kids, shoe soles, phyron sponges which is just right for ensuring safety from hazardous gases such as formamide and ammonia.

## 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 |

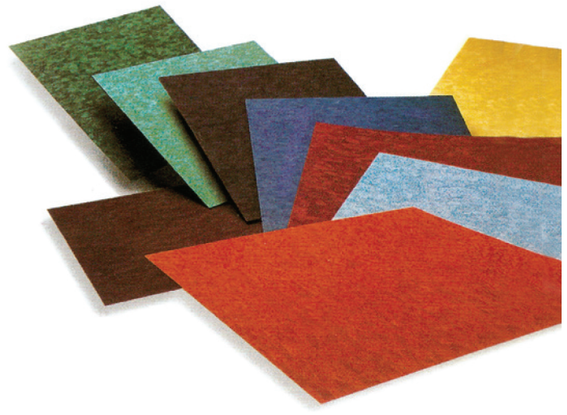
Gelling Condition 150℃ × 50sec.
Foaming Condition 230℃ × (30~60)sec.
Thickness of sheet 0.2mm

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

## 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 |



## 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

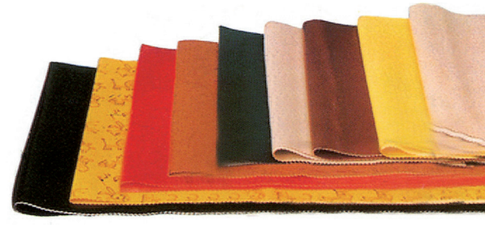
| | |
|---|---|
| PVC resin (p=1700) | 64 |
| PVC resin (p=1100) | 16 |
| PVC Blend resin (C-65V) | 20 |
| Filler | 20 |
| Plasticizer | 50 ~ 65 |
| TXIB | 5 |
| Stabilizer (Ba-Za) | 5 |
| Pigment | 3 ~ 5 |
| UNICELL-D1100 | 3.5 |

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)

| Ingredient \ Usage | 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<br>NBR(A.N. 41%)<br>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

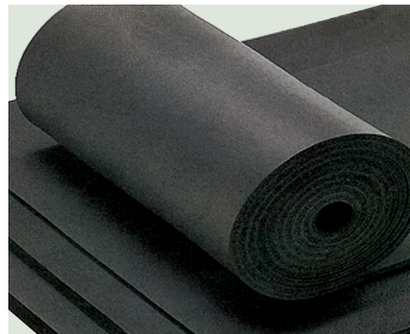
| | |
|---|---|
| PS, ABS/PS | 100 |
| UNICELL-C#709/C#850 | 0.4 ~ 0.7 |

Process Temperature 200 ~ 240℃

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

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

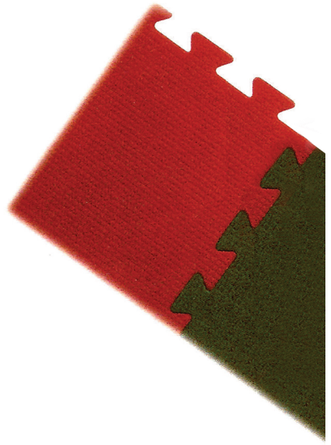
Compounding 15 ~ 20min. in dry tumble
Barrel Temperature back 193 ~ 199℃
mid 199 ~ 204
front 210 ~ 221
Nozzle Temperature 218 ~ 227
Mold Temperature 16 ~ 38



## 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

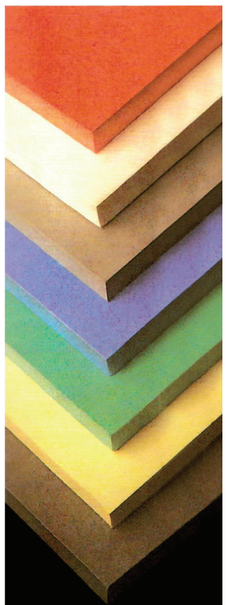
| | |
|---|---|
| LDPE | 100 |
| ZnO | 0.4 |
| DCP | 0.9 |
| D300L | 10 |

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.

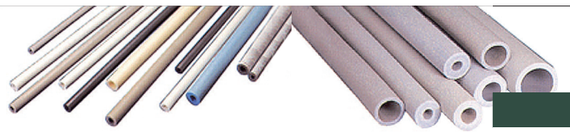
## EVA shoe sole (3)

| | |
|---|---|
| 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

| Ingredient \ Usage | 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 |



## 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/cm³

## 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)

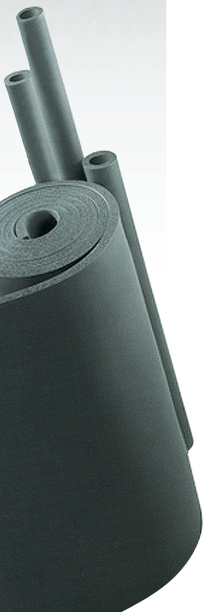
| | |
|---|---|
| LDPE | 100 |
| Ba-Stearate | 0.3 |
| Zn-Stearate | 0.3 |
| UNICELL-D1500CS | 21 |

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℃
Melting 180℃



## 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)

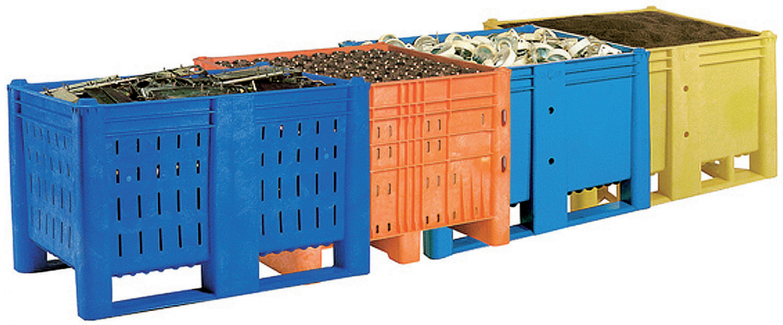
| Roll of UNICELL-C series | Foaming Agent | | Nucleating Agent | |
|---|---|---|---|---|
| Resin | PP, PS, ABS, PE, PVC | | PS, PE, PVC | |
| Foamed Material | Sheet | Film | Sheet | Film |
| UNICELL-C#709/C#850 | 0.5~0.7 | 0.4~0.6 | 0.4~0.6 | 0.3~0.5 |
| Processing Temperature(℃) | 190~220 | 190~220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



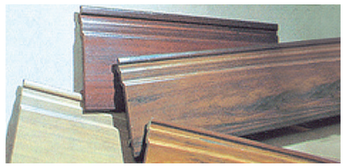
## NR,SBR Sponge (1)

| | | |
|---|---|---|
| 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/cm² | | |
| 2nd Stage | totally vulcanized foaming stage | | |
| Pressure | 30~50kg/cm² | | |
| 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/cm²
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**



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