Oxygen Absorber

AGELESS®

Oxygen Absorber
for preserving product
freshness, purity,
and integrity.

MITSUBISHI GAS CHEMICAL COMPANY,INC.

AGELESS®

"Iron absorbs oxygen when it rusts." "Prevent oxidation by eliminating oxygen." Just by implementing a combination of such simple ideas, Mitsubishi Gas Chemical was able to develop AGELESS the world's first oxygen absorber. AGELESS absorbs oxygen in a sealed container and creates a deoxidized environment, where the concentration of oxygen is 0.1% or less. This way, it is possible to preserve foods by eliminating the ill effects of oxygen. AGELESS preserves both the taste and freshness of food. This outstanding feature of AGELESS also expands its application to pharmaceutical products, clothing, and cosmetics. AGELESS is also used widely to ward off mold as well as mites from clothing and bedding.

AGELESS® absorbs oxygen to preserve good taste and freshness.

- AGELESS deoxidizes the interior of a sealed package in a way never before possible with conventional vacuum and gas replacement packaging. Even small amounts of oxygen, which infiltrate through the film surface are removed completely. AGELESS is a truly dynamic oxygen absorber.
- The flavor, color, fragrance and nutrition of freshly prepared food can now be retained for long periods of time.

AGELESS® assures safety and quality.

- AGELESS prevents the growth of molds and aerobic bacteria, while also preventing harmful insects.
- Oxidized oils and fats are a detriment to good health. They can be prevented by the deoxidization effect of AGELESS.
- Reducing amount of food additive.
- Various tests conducted by official organizations have confirmed the safety of AGELESS.
- AGELESS has been awarded the ISO9001 Quality System Certification.

AGELESS® is simple and effective.

- Conventional packaging such as vacuum packing and gas flushing package packing require devoted facilities, but you can use AGELESS just by providing a sealing machine.
- AGELESS can be inserted quickly and simply by using an automatic inserter.

AGELESS® has made distribution more efficient.

- Extending a food's shelf life allows food manufacturers to market greater varieties of food and expand their markets, while still retaining good taste and freshness.
- AGELESS allows for the simple and easy control of production and inventory.

This instruction manual is prepared for the correct use of oxygen absorber AGELESS®. For more effective use of AGELESS®, this instruction manual should be fully read before using AGELESS®.

Warnings and cautions

In order to prevent hazards to AGELESS users and other persons and damage to property, this manual explains the rules that must be observed with the following indications.

Warning	This indicates a hazardous situation which, if not avoided, will "result in death or serious injury."
Caution	This indicates a potentially hazardous situation which, if not avoided, may "result in minor or moderate injury or property damage".

This instruction manual classifies the levels of attention using the following pictograms.

indicates a "compulsory" action that must be performed.

indicates "calling attention" to an action.

indicates a "prohibited" action.

indicates to attention to heat generation.

- **Please read this instruction manual before use.**
- **Please keep this instruction manual with care.**

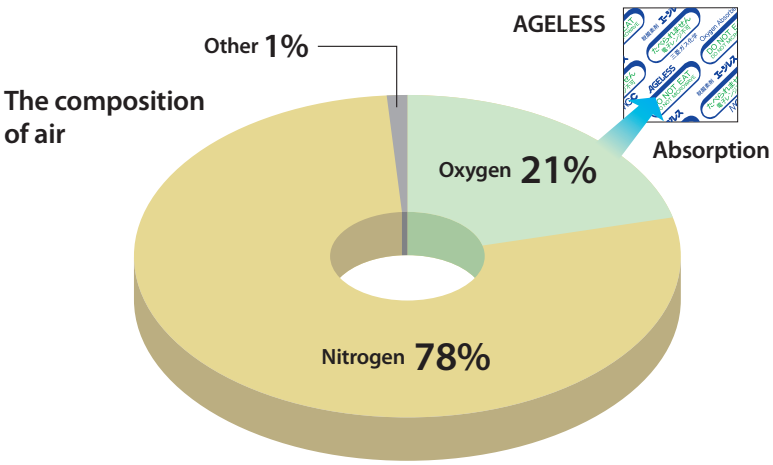
In adopting AGELESS, please conduct packaging tests under actual packing and distribution conditions to confirm the effect of AGELESS.

CONTENTS

What is AGELESS®?

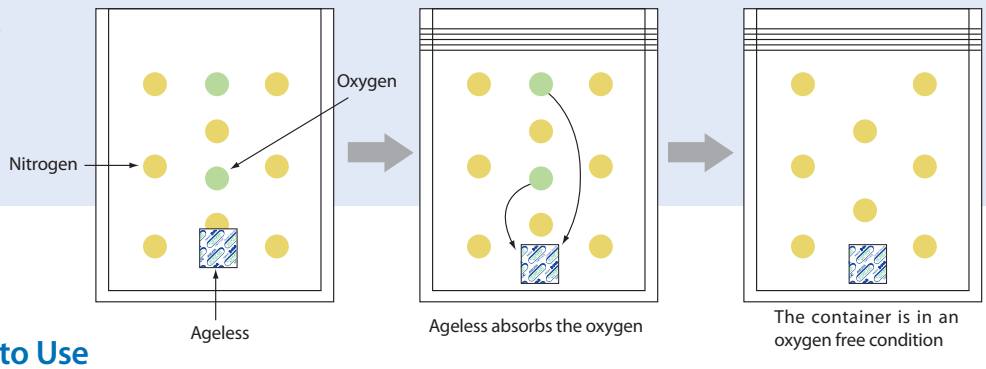
AGELESS® is the registered trademark of Mitsubishi Gas Chemical Company, Inc.
The main constituent of AGELESS (iron type) is a specially treated iron powder. When iron rusts, it absorbs oxygen in the process. The result is deoxygenation of the sealed container through oxidation, preventing any bad affects to the product. Other types of AGELESS use other organic matter such as vitamin C as their main constituents.

AGELESS® is used to create an oxygen free condition within a sealed container. It cannot be used for any other purpose.



Oxygen makes up approximately 21% of the air in the atmosphere, however AGELESS absorbs all oxygen within a sealed container to create an oxygen free condition (maintaining an oxygen concentration of 0.1% or less). As AGELESS absorbs more oxygen, the volume decreases and the gas remaining within the sealed container becomes mostly nitrogen, an inert gas.

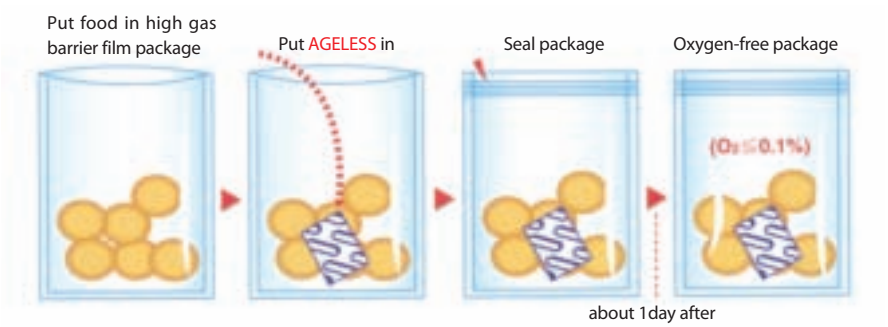
The AGELESS® process (outline)



AGELESS® is Simple to Use

AGELESS® preserves the freshness of your products and prolongs their shelf life.

- It will contribute greatly to marketing and distribution of your products.
- It is easy to use.
- It is economical since it requires no expensive equipment.
- It is safe since it will never be directly mixed with your products.



Conventional preservatives, antioxidants, gas flushing and vacuum packing often are not effective because they do not completely eliminate oxygen. Unique AGELESS oxygen absorber works to chemically absorb oxygen without altering product composition or purity without adding any chemicals or additives.

The main chemical reactions that occur inside the AGELESS® sachet are:

$Fe \rightarrow Fe^{2} + 2e^{-}$

$1/2O_2+H_2O+2e^{-} \rightarrow 2OH^{-}$

$Fe^{2+}+2(OH)^{-} \rightarrow Fe(OH)_2$

$Fe(OH)_2+1/4O_2+1/2H_2O \rightarrow Fe(OH)_3$

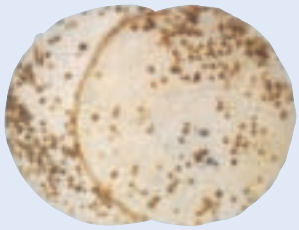
Effectiveness of AGELESS®

1. Inhibition of the Mold Growth (30°C x 10 days)

Pizza Crust

AGELESS packed

Control

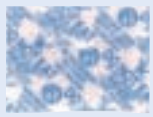


2. Wards off harmful insects (25°C x 1 month)

Rice

AGELESS packed

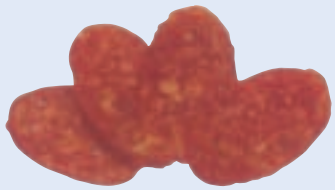
Control



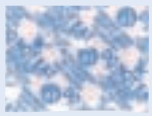
3. Prevention of Oxidation of Oils and Fats (20°C × 1 week)

Salami

AGELESS packed



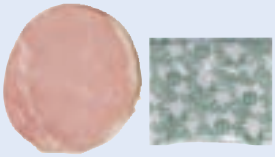
Control



4. Prevents color changes (5°C x 1 month)

Sliced Ham

AGELESS packed



Vacuum packed

N2 gas packed (O_2 =0.5%)

Control

5. Prevents color changes (-20°C x 6 months)

Salmon roe

AGELESS packed

Control

AGELESS® Prevents Molds

In an oxygen-free atmosphere (oxygen concentration of 0.1% or less) , AGELESS shows a marked ability to suppress the growth of molds.
The experimental results tabulated below show the growth progress of blue molds even when food items are stored under rigorous inert gas replacement packaging technology. A small amount of oxygen seeping in through the film raises the oxygen concentration to 0.3%, where blue molds are detected. Food items sealed with the AGELESS did not show this mold development.

Growth of blue molds in sponge cake and oxygen concentration (at 25℃)

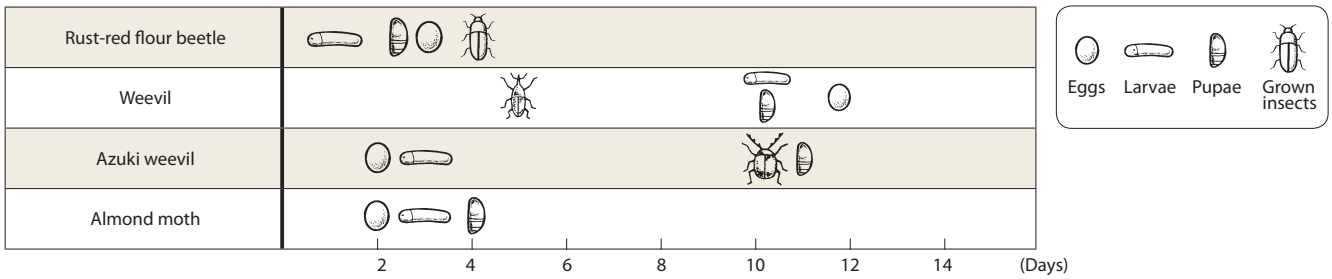
Packaging	Initial O_2 Concentration (%)	Storage Period (days)								O_2 Concentration When Detecting Hypha (%)
		3	5	7	9	12	14	16	20	
AGELESS	0.1 or less	-	-	-	-	-	-	-	-	-
Nitrogen gas replacement (99.9% or more)	0.1 or less	-	-	-	-	-	-	+	+	0.25
Nitrogen gas replacement (97.5%)	0.5	-	-	-	+	+	+	++	++	0.42-0.49
Nitrogen gas replacement (95%)	1.0	-	-	+	++	++	++	++	++	0.99-1.10
Nitrogen gas replacement (85%)	3.0	-	+	++	++	++	++	++	++	2.94-2.98
Control (air)	21	-	+	++	++	++	++	++	++	

Test Method: Blue mold specimen was implanted in the sponge cake to compare its grown in an AGELESS Pack environment and inert gas (nitrogen) replaced packaging.
Note 1) The oxygen concentration for the AGELESS is that measured after the absorption of free oxygen.
Note 2) The percentages appearing in parentheses for inert gas replacement packaging indicate the rate of replaced gas.
Note 3) Growth of mold colonies: (-) no mold colonies detected, (+) observable mold colonies, (++) large numbers of mold colonies.

AGELESS® is Effective on Insect Eggs

Oxygen-free packaging using AGELESS allows you to eliminate both adult insects and their eggs, which is not achieved by fumigation. AGELESS is safe: no more worries about residual chemicals. The table below list insects often found growing in cereals. AGELESS is also effective against mites hiding in bedding.

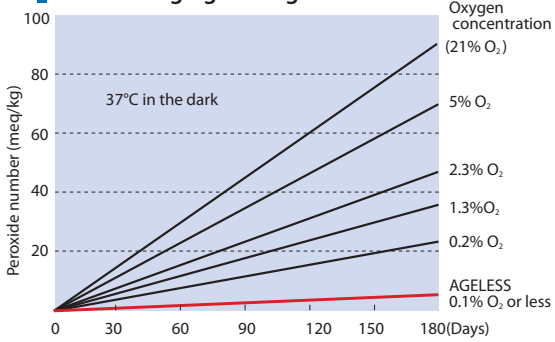
Number of days needed for 100% killing of insects by AGELESS package (at 25℃)



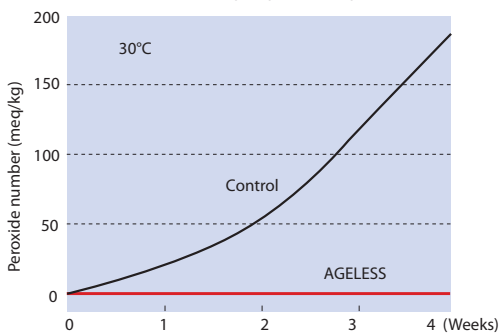
AGELESS® Prevents Oxidation of Fats and Oils

The quality of fats and oils deteriorates when they react with oxygen. Light and heat facilitate the oxidation process, which continues even when products are frozen. Oxygen-free packaging using AGELESS can prevent the harmful effects of oxidization. (The peroxide number indicates the degree of oxidation of fats and oils. The greater this number, the greater the degree of oxidation developing in fats and oils.)

Peroxide number of corn-oil (extract) sprayed rice cakes changing with age



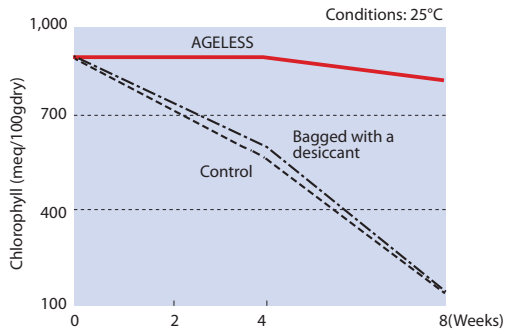
Peroxide number of refined fish oil (containing 30% DHA) changing with age



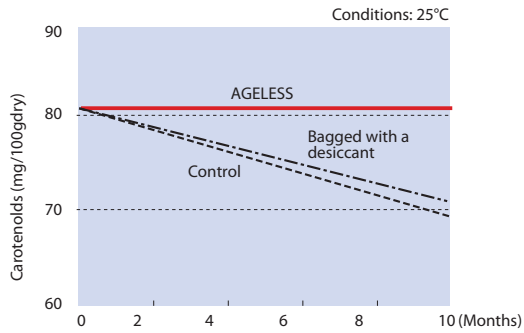
AGELESS® Prevents Food Colors from Changing

Oxidation of food causes its color to change. Natural pigments such as the chlorophyll (green) and carotenoids (red) change their colors rapidly, which is promoted by light and heat. Packaging with AGELESS prevents the discoloration of food.

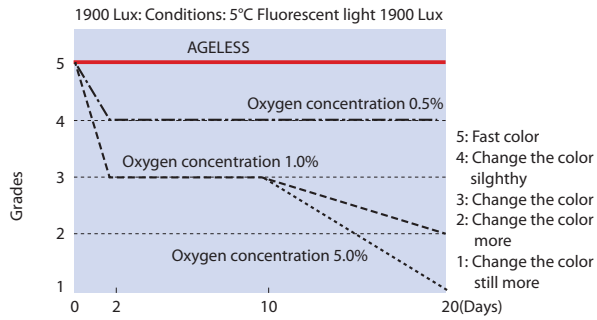
Change in dried welsh onions with age



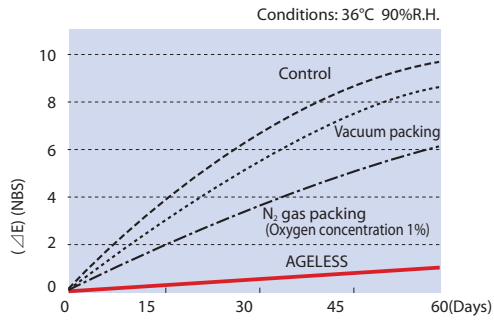
Change in the carotenoids in dried laver with age



Change in the color of sausage with age, at different oxygen concentrations



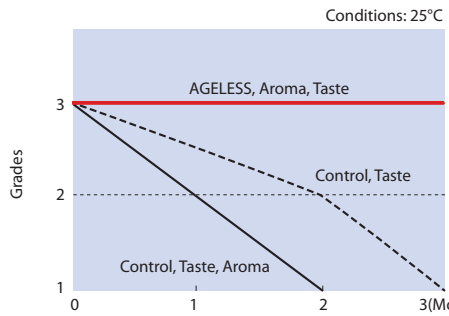
Change in the color of beef jerky with age



AGELESS® Preserves Both Flavor and Nutrition

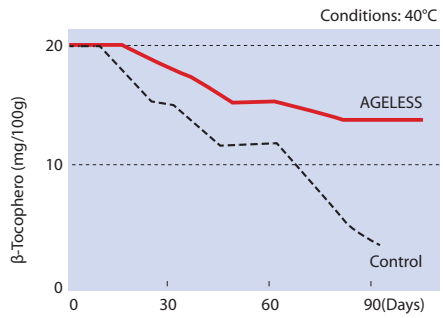
The attractive flavors of tea and coffee, or the vital nutrients, Vitamin E and C, are quickly deteriorated or lose their potency through oxidation. The graphs below showing the oxidation of Vitamin C with age demonstrate just how effective AGELESS is in retaining this important nutrient.

Change in coffee flavor with age

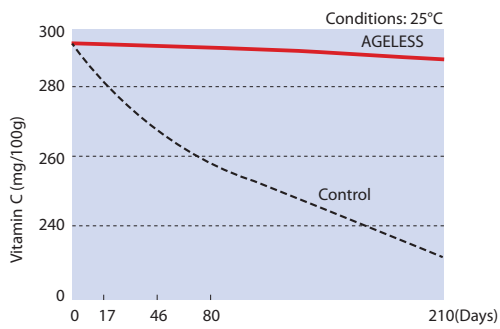


Grades:
Aroma
3:No Smell. The aroma of food is kept well.
2:A little smell of oxidation. The food aroma is fading.
1:Smell of oxidation. The aroma has gone.
Taste
3:The taste is like just after roasting.
2:Increased taste of oxidation.
1:The taste has gotten worse.

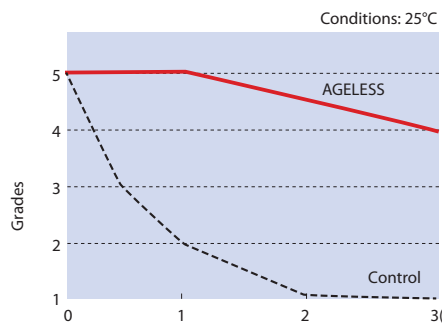
Change in Vitamin E of freeze dried tofu



Change in Vitamin C in tea with age



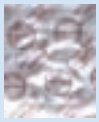
Change in almond cookies with age



Grades:
Aroma,Taste
5:The aroma and taste keeping well.
4:The aroma is fading a little.
3:A little smell of oxidation. The taste had got worse.
2:Smell and taste of oxidation.
1:Strong smell and taste of oxidation.

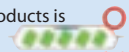
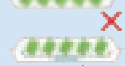
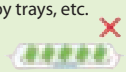
Various Types of AGELESS® for Various Purposes

In using AGELESS, it is necessary to select the type most suited for target products and packaging forms. A wide variety of AGELESS are lined up for product types and applications.

Variety and Feature				Type	Main Application		Water activity of product to be applied
Iron Type	Water Dependent		Oxygen absorption starts only in moist environment.	FX 	FX	Rice cakes, dumplings, raw noodles, soybean paste, bread crumbs, etc.	0.85 or more
					FX-L	Waffles, delicacies, ham, sausage, chicken nuggets, pizza crust, seasoned fish, pet foods, etc. Oil resistance	
	Self-Reacting	Absorption of oxygen begins when sachet are removed from outer master bag. Use as quickly as possible.	**Fast Acting Type** for foods with high or medium water content.	S 	SA SS-MBC	Pancakes, Castella (Japanese sponge cake), Baumkuchen, pizza, semi-dry confectioneries, madeleine, etc. Oil resistance	0.65 to 0.95
					SS	Fresh fish fillets, fish eggs, etc. For freezing and refrigeration. Oil resistance	0.65 to 0.95
			Standard Type for foods with low or medium water content.	ZP ZPT 	ZP ZPT	Tortilla, doughnuts, cakes, fresh cakes, brandy cakes, salami, beef jerky, pet foods, etc. Oil resistance	0.95 or less
					Z-PK	Coffee, tea, nuts, dried vegetables, spices, laver (seaweed), and pharmaceutical products.	0.65 or less
			Coffee Oxygen and carbon dioxide are both absorbed simultaneously.	E 	E	Coffee	0.3 or less
Non Iron Type	Self-Reacting	**Oxygen Absorbing Type**		GLS 	GLS	Ham, sausage, chicken nuggets, etc. Oil resistance	0.3 to 0.95
		Multi-Function Type Carbon dioxide generation starts simultaneous with absorption of oxygen. Prevents food containers from shrinking when oxygen is absorbed.		GE 	GE	Nuts, dried fish, etc. Oil resistance	0.3 to 0.9

Size of AGELESS®

Size	20	30	50	100	200	300	500	1000	2000	3000
O_2 absorption capacity(ml)	20	30	50	100	200	300	500	1000	2000	3000
Equivalent air volume (ml)	100	150	250	500	1000	1500	2500	5000	10000	15000
Series	FX FX-L									
	SA									
		SS								
	ZP ZPT									
	Z-PK									
	GLS									
	GE									

Types and precautions for use	Precautions for packaging form and insertion position	Deoxygenation time (25°C)	Handling time to open air (25°C)
[Water-dependent type] ・Because AGELESS itself does not contain any moisture, contact with moisture evaporated from products causes AGELESS to initiate reactions. AGELESS is unable to be used for dry foods. ・Insert AGELESS into the position where moisture is easy to reach. ・FX and FX-L are single-sided absorption types. Enclose AGELESS with the absorbing surface (plain white surface) directed to the product. ・For products that contain alcohol or products to which alcohol is sprayed, FX-L type is suited but it is recommended to confirm the effect by tests using actually packaged products before use.	Insert AGELESS into the position where moisture evaporated from products is easy to reach.  AGELESS is not suited for this kind of packaging form.  According to the degree of moisture and oil contents, even water-resistant type and oil-resistant type are unable to successfully provide desired effects. This must be confirmed by tests using actually packaged products before use.	0.5 ~ 1 day	25°C, 8 hrs: RH*<70% 25°C, 4hrs: RH70 to 90% In case of using under 35°C, handling time become shorten to a half of the above. *Relative humidity at room
[Iron-based self-reacting type] ・AGELESS itself contains moisture necessary for reactions, and contact with air causes AGELESS to initiate oxygen absorption. ・Unlike the water-dependent type, no restriction is placed to the packaging form and insertion position. ・There is a fast-acting type (SA) that absorbs oxygen quickly and a standard type (ZP, ZPT). [Fast-acting type S-series] For foods which are perishable and contain a large amount of moisture. ・SA and SS-MBC : Outstanding water resistance, oil resistance, and acid resistance. Able to be used for refrigerated products. ・SS: For frozen and refrigerated products. Outstanding water resistance and oil resistance. [Standard type Z-series] ・ZP and Z-PT: Standard-purpose type for medium and high moisture containing products. Outstanding water resistance and oil resistance. Extensive size line up from 20 to 3000. ・Z-PK: For low moisture content. Outstanding flavor retention capabilities. Able to be used in combination with a desiccant.	Not too much particular about packaging forms or insertion places.  AGELESS may be inserted into such a manner as to come in direct contact with food but may not achieve desired effect according to food moisture and oil contents. In such event, AGELESS must be separated by trays, etc.  Tray bottom is flat and poor air permeability occurs.  Individual products are too tightly packaged to deoxidize the inside of individual packages.	0.5 ~ 1 day	Within 2hrs *As for roll form, refer to P.19 and 20.
		(5°C 0.5~1 day) (-20°C 3 ~ 5 days)	Within 1hr *As for roll form, refer to P.19 and 20.
		1 ~ 2 days (3 ~ 5 days; size 500<)	Within 4 hrs (1hr: AW<0.65) *As for roll form, refer to P.19 and 20.
		3 ~ 4 days	Within in 4hrs *As for roll form, refer to P.19 and 20.
[Self-reacting type for coffee] ・AGELESS absorbs oxygen simultaneously with carbon dioxide roasted coffee beans generate. ・Size indicates the carbon dioxide absorption rate. ・AGELESS simultaneously absorbs oxygen one-tenth as much as the carbon dioxide.		3 ~ 8 days (2,000=9 to 16 days)	Within 4hrs *As for roll form, refer to P.19 and 20.
[Non-iron-based self-reacting type] ・For main ingredients, organic-based substances are used. Low detection sensitivity is achieved for a metal detector. ・Equivalent to or lower than iron balls of Ø1.0 mm. According to metal detectors, setting of non-ferrous balls may be required. ・GLS absorbs oxygen only. ・GE generates carbon dioxide of a nearly same amount of oxygen absorbed to prevent shrinkage of packaging material resulting from oxygen absorption.	Same as iron-based self-reacting type. 	1 ~ 3 days	Within 1hr *As for roll form, refer to P.19 and 20.
		1 ~ 3 days	Within 1hr *As for roll form, refer to P.19 and 20.

Size	250	500	1000	2000
CO_2 absorption capacity(ml)	250	500	1000	2000
O_2 absorption capacity(ml)	25	50	100	200
Series	E			

*These lists are based on the Japanese version of AGELESS.
As for the overseas version, please contact our sales offices.
*Obey the regulations of each country.

*To prevent shrinkage of packaging, combined use of AGELESS and nitrogen gas packed packaging or use of AGELESS GE type which generates carbon dioxide are effective, but since carbon dioxide gas dissolves in moisture and oil content in food, the packaging may gradually shrink as a result according to foods.

*AGELESS packed in continuous rolls for automatic charging in linkage with a packaging machine is available in addition to individually packed AGELESS (Automatic AGELESS charging machine is required).

Each series is further divided into types more applicable to specific product situations.
For more information, please ask sales office about detailed types of AGELESS.

Sheet type AGELESS®

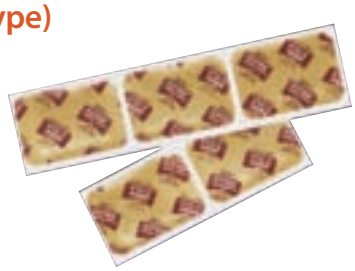
With the development of our "oxygen absorbing plastic sheet", we are able to introduce oxygen absorbers in totally new styles.
These new products no longer use powder ingredients in a sachet.
Therefore, even if consumers tear them off, there is no possibility of releasing ingredients. Furthermore, they possess resistance to microwave.
In this new "oxygen absorbing plastic sheet", the active ingredient (activated iron powder) is contained within the plastic material.
You can create much more consumer friendly packages, because these new models can be designed to fit into your packages naturally and can serve multiple functions.

Types and sizes of AGELESS®(Water dependent types: FL·FC·FP·FS)

1 **Securely attachable, AGELESS Label is best suited for automatic packaging.**

AGELESS FL (Label type)

Just like ordinary labels, the backside is coated with an adhesive. This way, it is easy to securely place AGELESS inside any food package. If an automatic labeling machine is used, you can attach AGELESS Labels automatically. AGELESS Label fits any packaging material.



2 **Devise many ways to use AGELESS Card, either as a package base or a page marker.**

AGELESS FC (Card type)

AGELESS Card allows for new, innovative applications. Available in round or square designs, AGELESS Card can be made to order to customer-specified design, size and prints. Contact one of our sales representatives for further details.

3 **Best suited for inserting in bottles.**

AGELESS FP (Packing type)

The use of AGELESS products has been difficult in bottles, but AGELESS Packing offers a new solution. It fits snugly in a bottle and is inconspicuous. Integrated with the inside of a bottle's lid, AGELESS Packing absorbs oxygen and keeps the contents fresh. Also there is no risk of accidental swallowing. AGELESS Packing is made to order to match the cap size.

4 **The pouch-type AGELESS does not use pulverized materials.**

AGELESS FS (New sachet type)

These are very small, slim AGELESS packs using oxygen absorbing base sheets. Use these new kinds just like other AGELESS pouches. Available in two forms: individually packed or in continuous rolls. The rolled products can be inserted with an ordinary automatic inserting machine by adjusting the machine's sensor.

Deoxygenation time/Handing time

Types of AGELESS	Deoxygenation time at room temperature (25°C)		Handling time to open air
	Water activity of product to be applied	Days	25°C, 8 hrs: RH<70%* 25°C, 4hrs: RH70 to 90%* In case of using under 35°C, handling time become shorten to a half of the above.
FL/FC/FP	1.00 ~ 0.80	0.5 ~ 1 day	
	0.80 ~ 0.75	1 ~ 2 days	
FS-L	1.00 ~ 0.85	0.5 ~ 1 day	
	0.85 ~ 0.75	1 ~ 2 days	

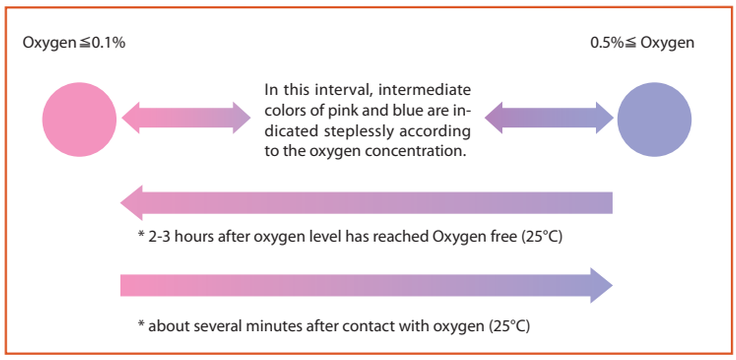
*Relative humidity at room

Sizes of AGELESS

Size		5	10	15	20	30	50
O_2 absorption capacity(ml)		5	10	15	20	30	50
Equivalent air volume(ml)		25	50	75	100	150	250
Type	FS				FS		
	FC			FC			
	FL	FL					

AGELESS-EYE® Oxygen Indicator

The AGELESS-EYE is an in-package monitor which indicates the presence of oxygen at a glance. Please use it for testing purposes only.



How to storage and guarantee period of AGELESS-EYE®

AGELESS-EYE® are delivered by room-temperature courier service, but upon arrival, immediately place them in a refrigerator and keep them at not higher than 15°C with care to prevent exposure to light.

* The oxygen concentration and time required for discoloration are merely good rule-of-thumbs and not guaranteed values. Discoloration takes place more slowly at low temperatures.

Type of AGELESS-EYE®	Guarantee period	Use condition
Tablet type with string	6 months after shipment	5 ~ 35°C, AW 0.10 ~ 0.99

How to use AGELESS-EYE®

- Take out a required quantity from a master bag.
- Enclose AGELESS-EYE together with AGELESS one by one.
- Use AGELESS-EYE within 12 hours. Incidentally, for using AGELESS-EYE under working environment with care to avoid exposure to direct sunlight or particularly strong light (brightness: not more than 500 lux).
- Leaving AGELESS-EYE in air for a long time, exposing to light for a long time, or storing at high temperature (over room temperature) degrades performance of AGELESS-EYE.
- AGELESS-EYE can not be reused, because the performance gradually degrades.
- After unpacking, store AGELESS-EYE in a refrigerator at temperature not higher than 15°C, with self-reacting type AGELESS Z type or S type (size: not less than 100) enclosed, hermetically sealed, and shielded from light in the deoxidized condition.

The pink color tone of AGELESS-EYE indicates that the container inside is in the deoxidized condition, and does not directly indicate the packaging state or the quality of products inside.

Precautions for Use of AGELESS-EYE®

- Be sure to perform tests using actually packaged products before use.
- In the event that products with AGELESS-EYE enclosed are stored at high temperature (about 40°C or higher), AGELESS-EYE may not allow normal color change to take place.

	Tablet type EYE
Check before use	The master bag is deoxidized and packed. Make sure AGELESS-EYE inside assumes a pink color before unpacking, and then, use the products inside.
Precautions	• Do not attempt to take out the tablet from the film and use. • Do not make a cut in the film window by a utility knife, etc. • AGELESS-EYE has limits, so it is recommended to check by performing tests using actually packaged products.

How to Make an AGELESS® Pack

AGELESS can be combined with a high gas barrier packing material to absorb the oxygen within an airtight package and maintain an oxygen free condition for a certain period of time. This type of packing is referred to as an "AGELESS Pack".
This page outlines how to use AGELESS correctly and how to create an AGELESS Pack.

Four conditions to maintain an oxygen free condition

Condition 1

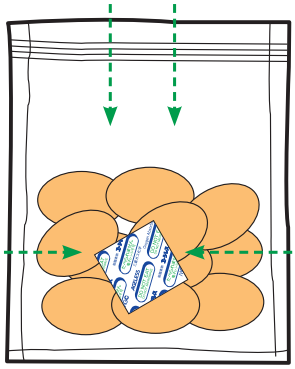
Use packing material with a high gas barrier

In order to maintain an oxygen free condition for a certain period of time, select packing material with a high resistance to oxygen permeability. AGELESS Pack use materials with a high gas barrier such as plastics, trays, metal cans and glass bottles.

Condition 2

Select AGELESS that suits the product characteristics and volume of container packing

To ensure that the container is deoxygenated within the required time, select a type of AGELESS that suits the product characteristics and packaging form, and select the size that suits the amount of oxygen in the packaging.



Condition 3

Create a perfect seal with a sealing machine

AGELESS Pack must be completely sealed to maintain their oxygen free condition. A heat sealer can be used to seal the container.

Condition 4

Correct handling of AGELESS

Inappropriate handling of AGELESS can render the product useless. Handling conditions differ according to the type, so the conditions for sealing, use and storage explained in the instruction manual should be followed promptly and accurately.

Once an AGELESS® Pack has been created, an actual test should be performed to check the effects of sealing.

Use the following procedures to test the actual shape of the product.

1. Insert the prepared product into the packaging.
2. Insert AGELESS and AGELESS-EYE into the packaging. The deoxygenation time will differ depending on the position of AGELESS. Test the packaging with AGELESS positioned as it will be used in the final product.
3. Use a heat sealer or wrapping machine to seal the package.
4. Enter the expected opening date of the package and store under the prescribed storage conditions (temperature etc).
5. Open the package after checking (immediately after opening in the case of a can) the color of AGELESS-EYE to determine whether deoxygenation is complete for each opening date, and check the quality of the product. Check the appearance, smell and taste of the product.
6. Determine the use-by-date.

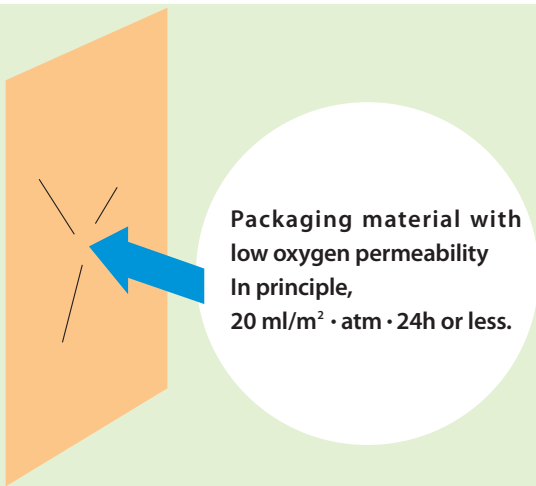
Planning for the actual test

- Products should be placed in the same production lot with the quantity to match the number of tests to be performed. Set the test period in relation to the target use-by-date.
- Products with good storage life can have a longer time before opening, whereas the time for products with poor storage should be shortened.
- Several quality assurance officers should be assigned to check the quality of the product. The same officer should check the quality of the product each time.
- A test plan should be created to assist in tests with many different conditions.

Choosing Packaging Material

Condition 1 **In order to keep the inside of the container in the state of oxygen free for a certain time, it is necessary to choose packaging material with low oxygen permeability. In principle, choose packaging material whose oxygen permeability is 20 ml/m² · atm · 24h or less.**

[Oxygen permeability of packaging material]



Packaging material for low moisture product

Use packaging material with a high gas-barrier property regardless of preservation period when using AGELESS together with a desiccant.

Packaging material for long-term preservation

The longer the preservation period, the higher gas-barrier property is required for packaging material.

Gas-barrier property of molded container

Even material with a low gas-barrier property may be available according to thickness. Check the gas-barrier property with a packing test using AGELESS.

Generally, the oxygen permeability and water vapor permeability of packaging material will change according to the temperature and humidity of the preservation environment, water activity of the content, etc. The oxygen permeability of some packaging material will drastically rise (decline in gas-barrier property) when preserved in a high humidity environment or applied to a food whose water activity is high. When choosing or changing packaging material, be sure to conduct a packing test in advance to check the suitability of the packaging material. The table below provides reference data and suitability.

Aptitude	Type	Composition	Thickness (micron)	Oxygen permeability* ml/m², 24hs20-25°C	Vapor permeability (g/m², 24hrs)
Long-term preservation	Aluminum foil	PET/AI/PE	12/7/40	0	0
	Aluminum deposition	PET/evaporated AI/PE	12/40	0.5 ~ 1.5	1 ~ 1.5
	Si oxide coat	Si oxide coating PET/PE	12/60	0.5 ~ 1.5	0.3 ~ 1.5
	Ethylene vinyl alcohol	OPP/EVOH/PE	20/17/40	0.3 ~ 4	7
	Barrier nylon	MXD6/PE	15/40	5	9
	PVDC coat	PVDC coating OPP/PE PVDC coating PET/PE PVDC coating ON/PE	20/40 12/50 15/50	5 ~ 15 6 ~ 10 6 ~ 10	4 4 7
Short-term preservation(★)	PVA coating or extruded film	PVA coating OPP/PE EVOH coating OPP/PE	20/40 20/40	1 ~ 5 (200/90%RH) 1 ~ 5 (90/90%RH)	4 4
		When being applied to high AW food or being stored under high RH, adequate attention must be exercised			
	Polyamide	2-layer extruded film 3-layer extruded film (high barrier film) ONY/PE	100 60 ~ 90 15/40	11 ~ 30 25 ~ 70 (1 ~ 9) 30 ~ 120	7 ~ 9 5 ~ 15 16
	Polyester	PET/PE	12/40	50 ~ 120	15
Inappropriate	Polypropylene	OPP/PE CPP	20/40 40	1,500 ~ 2,000 3,000	6
	Polyethylene	PE	40 ~	2000 ~	

★:When using packaging material whose suitability is indicated with this mark for AGELESS Pack, conduct a packing test, etc. very carefully to determine the propriety of adoption.

Abbreviations:
PET = polyester, AI = aluminum, PE = polyethylene, OPP = oriented polypropylene, EVOH = ethylene-vinyl alcohol copolymer, PVA= polyvinyl alcohol, PVDC = polyvinylidene chloride, ONY = oriented nylon, CPP= cast polypropylene

*Oxygen permeability is also indicated with SI unit (ml/m², MPa, 24h).
The oxygen permeability in SI unit is obtained by multiplying 9.87 by the corresponding value * of the table since 1MPa ≒ 9.869atm.

Choose the AGELESS® Type

Condition 2 **Choose the best suited type in accord with the food types, properties, packaging forms, and specific applications.**

- Basically, choose the water-dependent type when AGELESS is loaded in "direct" contact with foods containing a high percentage of moisture that causes "mold" to grow. When such foods are individually packaged, or placed in trays or fancy boxes, and AGELESS is "indirectly" loaded on the outside of such packages, trays, or boxes, choose self-reacting type.
- Because almost self-reacting types provide water resistance and oil resistance, irrespective of packaging forms, "direct" and "indirect" loading of AGELESS are enabled for medium-moisture and high-moisture foods. In this regard, however, for foods containing a high percentage of moisture, "mold" grows quickly, and the quick-acting type AGELESS shall be used.
- For low-moisture foods, self-reacting standard type AGELESS is used. Irrespective of packaging forms, AGELESS is able to be "directly" and "indirectly" loaded.

[How to choose AGELESS® types by food moisture content and packaging forms]

Food moisture content (good rule-of-thumb for water activity	Packaging form (AGELESS inserted position)		
	AGELESS is inserted "directly" in contact with foods. 		AGELESS is inserted "indirectly." AGELESS is inserted to the outside of individual packages, trays, boxes, etc. 
	Oil-free foods	Foods containing oil	
Particularly high moisture content (0.95 or higher)	FX	FX-L, sheet type	-
High moisture content (0.85-0.95)	FX	FX-L, sheet type	SA ZP ZPT GLS (irrespective of packaging forms)
Medium moisture content (0.65-0.85)	SA ZP ZPT GLS		
Low moisture content (0.3-0.65)	ZP ZPT GLS		
Particularly low moisture content (0.3 or less)	ZP ZPT Z-PK (non-oil resistant) E (non-oil resistant)		

- According to the degree of moisture content or oil content of foods, satisfactory effects are unable to be obtained with types with water resistance or oil resistance. Besides the moisture content and oil content, penetration of alcohols may impede oxygen absorbing functions of AGELESS. It is recommended to perform tests using actual packaged products. In addition, there are cases to isolate AGELESS from moisture or oil by changing the packaging form, such as use of trays, etc.

[Selection of AGELESS® Type by specific applications and foods (Type specified)]

Applications and foods		Type	Remarks
Specific applications	Concomitant use with a desiccant	Z-PK	Effective for foods with extremely little moisture content (Aw 0.3 or less) such as freeze-dry products.
	Use of metal detector	GLS GE	Metal detector sensitivity is equivalent to or lower than iron ball φ10 mm. Depending on metal detector, setting to non-ferrous ball may be required.
	Avoidance of shrinkage of package	GE	AGELESS generates carbon dioxide in the amount nearly same as that of absorbed oxygen, but carbon dioxide dissolves in moisture content or oil content of food and changes food taste or causes the package to gradually shrink. In such event, combined use of other types and nitrogen gas filling is effective.
	Frozen storage	SS	For cold storage, use SA.
Specific foods	Roasted coffee beans and powder	E	The carbon dioxide generation rate varies in accord with kind of coffee beans and degree of roasting. Confirm the effect with actually packaged products before use.
	Foods containing acids	SA	Contact our staff for foods with particularly high acidity such as kelp flakes.

- Contact our support staff for ambiguous points, when there are many restrictions in food properties or packaging forms, or many combination conditions of specific applications, applications to fruit and vegetables, etc.

Measurement of the Oxygen Volume in Your Container

Condition 2 **In order to determine the correct AGELESS® size, you'll need to know the volume of oxygen in your container.**

What is the AGELESS® size?

The amount of oxygen that can be absorbed is indicated (in milliliters) by the AGELESS® size number. (Example: FX-50 will absorb 50ml of oxygen. Since oxygen makes up about 1/5 of the air, FX-50 will deoxygenate 250ml of air.)

How to measure the oxygen in your container

Oxygen in container(ml) = (Air volume in container(ml) – Weight of product(g) / Specific gravity) × 0.21

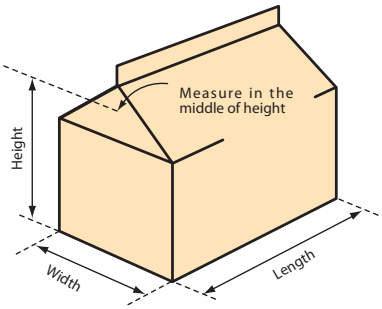
- The air volume inside a container is obtained by subtracting the volume of content product from the volume of the overall container.
- The density is the weight per 1ml, and in general, the food density is able to be roughly computed by being regarded as 1 g/ml.

Food examples whose density is computed other than by 1g/ml

Rice cake: 1.2; grain: 1.4; fresh noodles: 1.2, etc.
In the case of metals, the specific density is applied.

How to measure the oxygen volume

1. When using a box: Subtract the weight of product from volume of box.



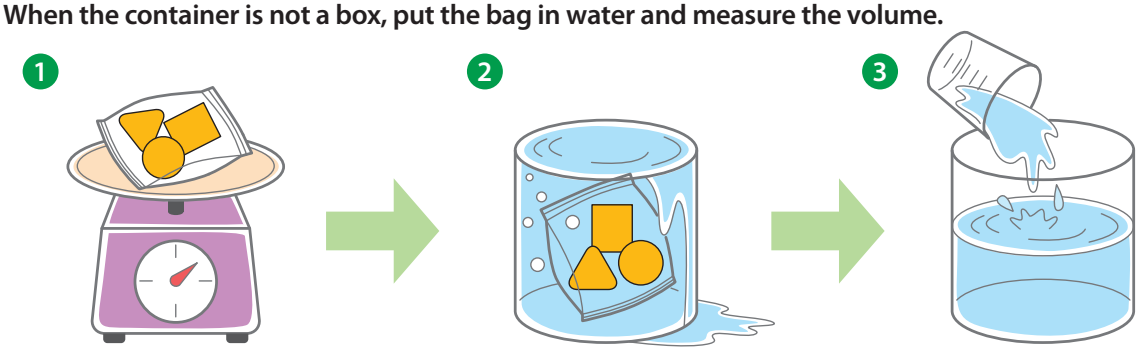
Example: Container size: 15×10×10cm, weight of product: 600g, specific gravity: 1g/ml.

Oxygen in container= [(15×10×10)-600/1]×0.21=189ml

Air Volume in container | Weight of product/specific gravity | Rate of oxygen

Consequently, choose slightly larger and closest size 200.

2. When the container is not a box, put the bag in water and measure the volume.



1. Measure the weight of food and container.
2. Fill vessel with water. Place product container into vessel and let water overflow.
3. Measure the make-up water volume.

Example: Make-up water volume 900ml, weight of product 500g, specific gravity 1g/ml.

Oxygen in container= (900-500/1)×0.21=84ml

AGELESS size 100 should be selected.

Hermetically Seal Packaging Containers

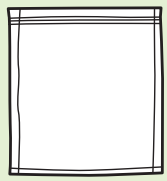
Condition 3 **Even if packaging material and containers with high gas barrier capabilities are used, effect of AGELESS pack is unable to be obtained unless packaging containers are completely heat-sealed or seamed.**

Points and precautions for heat seal

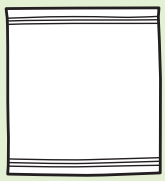
- A heat sealer is used for hermetically sealing film containers, but heat seal is
  [**1**] to melt the adhesive layer (sealant material) on the packaging material inner surface by heat;
  [**2**] to apply pressure to allow the molten adhesive layer to fill clearances and allow films to adhere tightly together; and
  [**3**] to cool the adhesive layer to solidify, and to hermetically seal the films.
- The quality of heat seal is determined by the heating temperature, pressure, and heating time. Set these conditions properly.
- In principle, use a heat sealer that heats the material from both sides. In the case of one-side heating, perfect sealing might not be achieved depending on shapes of packaging bags or heat sealer models, to which care must be taken.

Film containers

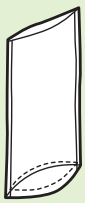
AGELESS® pack achieves no desired effect unless it is completely sealed.



3-way seal bag

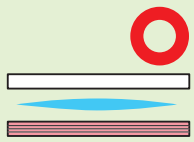


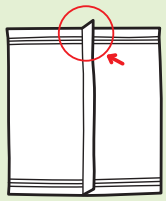
Tubular-shape bag



Standing pouch

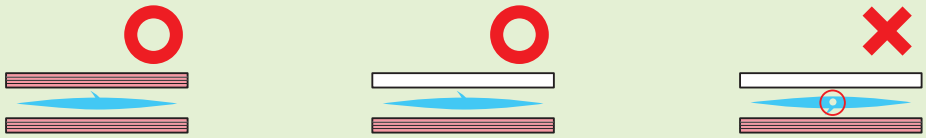
- Shape that can be sealed most securely.
- Able to be sealed by a one-side heating sealer.

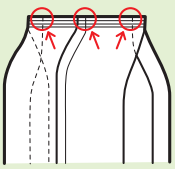




Backlining (pillow) package

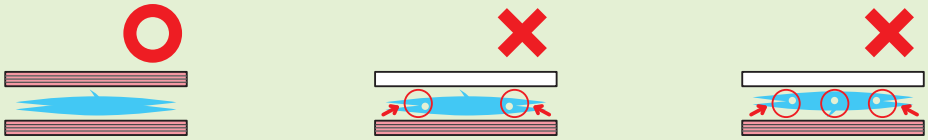
- The backlining portion tends to form a tunnel.
- Use a heat sealer that heats the material from both sides as much as possible (in the case of one-side heating, direct the side with no backlining to the hot platen).





Gusset package

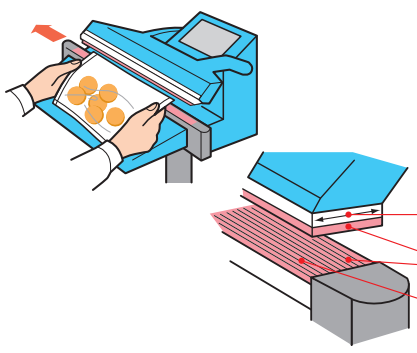
- The folded portion tends to form a tunnel.
- Choose packaging material with good adhesion and use a heat sealer that heats the material from both sides.



In the case of a foot-operated or hand-operated sealer:

- In the case of a foot-operated or hand-operated sealer, the seal pressure or seal condition may vary in accord with workers. Every time the worker is changed, make sure the seal is correctly made each time.
- When sealing is performed, lightly pull both edges of the film with care to prevent film wrinkles from being formed at the sealed portion. In addition, avoid any powder or any liquid from entering the sealed portion.
- A sealer with wide sealing width (not less than 10 mm) and with horizontal seal direction marking is recommended. A sealer with narrow sealing width tends to give rise to seal failure when any foreign matter is included or any wrinkle is formed.

<Foot-operated or hand-operated sealer>



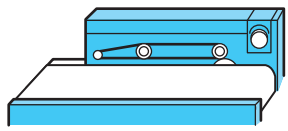
Take care not to form wrinkles at the film sealing portion.

•Good sealer

In the case of a belt sealer:

・In the case of an endless type belt sealer, properly adjust the parallelism of hot platens and belt speed (seal speed), too.

<Belt sealer>



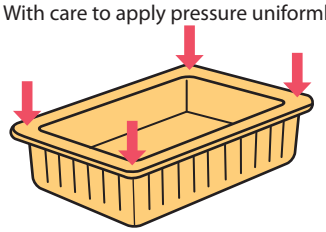
Accurately adjust temperature, heating time, and pressure.

In the case of a molded container:

・When a molded container is top-sealed, use care to apply homogeneous pressure to the whole container. In particular, take care to corners of a square container.

<Molded container>

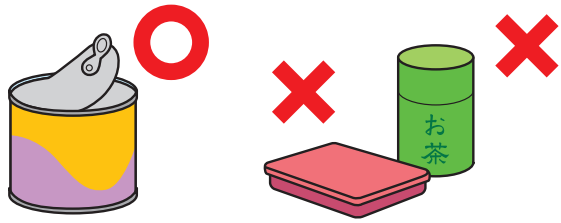
With care to apply pressure uniformly.



In the case of a metal container

・In the case of a metal container (can), make sure the seam portion is free of any air leakage.
Tea cans and fancy cans generally lack air-tightness and are unable to be used for AGELESS pack.

<Metal container>

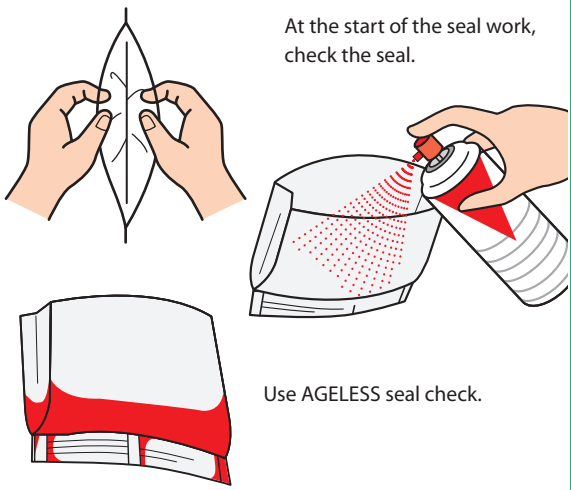


How to check the seal condition

Check method by AGELESS seal check

・At the start of the seal work, check the seal condition. Pull the package as illustrated below when the sealed portions are cooled. If the sealed portion is easily separated, it is adhesion failure. To check the backlining portion or gusset portion, use AGELESS seal check.

<How to check the seal condition>



At the start of the seal work, check the seal.

Use AGELESS seal check.

How to check in water:

・It is effective to check seal failure or pinholes by pressurizing a bag in water, too.
・Firmly press the bag containing foods by both hands in water and make sure any air bubble comes out from the bag.
・Utmost care is required for the printed portion of a hot printer.

<How to check seal in water>

Firmly press by both hands.

Use AGELESS®

Condition 4	The handling method of AGELESS varies in accord with types. Comply with the conditions stipulated in this document, and properly unpack, use, and store AGELESS.

AGELESS® storing method and guarantee period

・AGELESS®

Store AGELESS packed in carton boxes at room temperature (however, not higher than 30℃ even in the summertime) with care to avoid exposure to direct sunlight.
The guarantee period is 6 months after shipment.

In the event that AGELESS® is erroneously used, AGELESS® absorbs oxygen in air before packaging and is unable to exhibit the expected effect. Strictly abide by the correct handling method in order to enable AGELESS® to exhibit the effect satisfactorily.

Used AGELESS® can not be reused because the performance might be gone.

Handling of AGELESS® in the case of loose form

Be sure to check before use.

AGELESS is vacuum-packed by a master bag that makes it difficult to allow oxygen to permeate.
By checking the vacuum condition, it is able to confirm in advance the generation of pinholes during transportation and handling and product defects caused by breakage of a master bags.

How to check the vacuum condition

Pinch the end of the outer bag and lift up. Make sure the content does not slip down.

We will replace AGELESS whose vacuum of a master bag is lost when the carton box is opened. Contact our distributor.

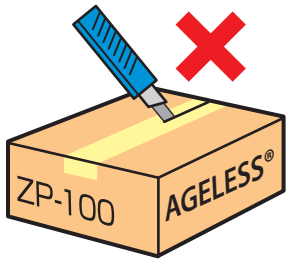
<How to check the vacuum condition>

good

bad

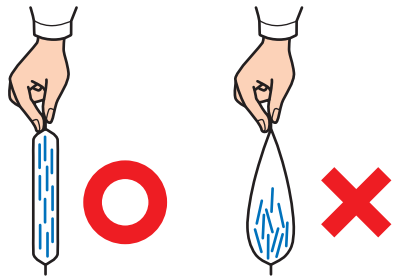
How to Use AGELESS®

1 Opening the carton box.



When opening box, avoid using too sharp an edge. (There is a possibility of damaging master bags.)

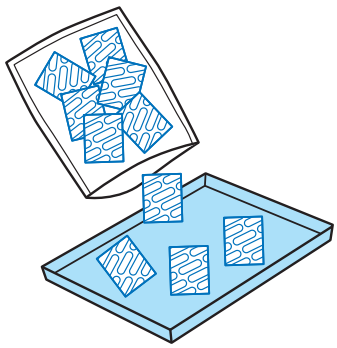
2 Check tightness of the master bag.



AGELESS is vacuum packed. If you hang master bag from one end, the packets should not slip.
In case the packets should slip before opening, do not use that master bag of AGELESS.

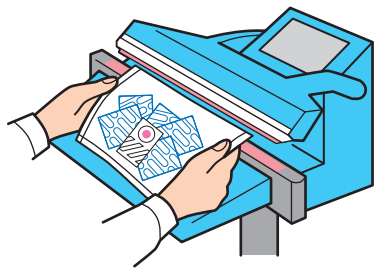
3 After opening master bag.

Spread out the needed quantity on a tray.



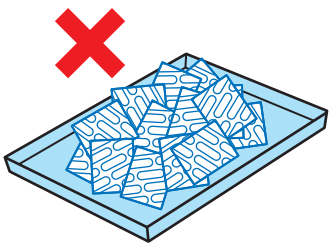
Use AGELESS spread out, with care to prevent them from lying one on top of another.
(Do not replenish until the box or the tray becomes completely empty.)

4 Remaining AGELESS.



The sachets which are not used should be resealed in a master bag or discarded if their handling time exceeds the maximum.

The remaining sachets should be resealed in a master bag after pressing out the air.



Do not pile up AGELESS in the tray.

Do not use AGELESS one by one from a master bag.

Use AGELESS®

Handling of AGELESS® in continuous rolls

Be sure to check before use

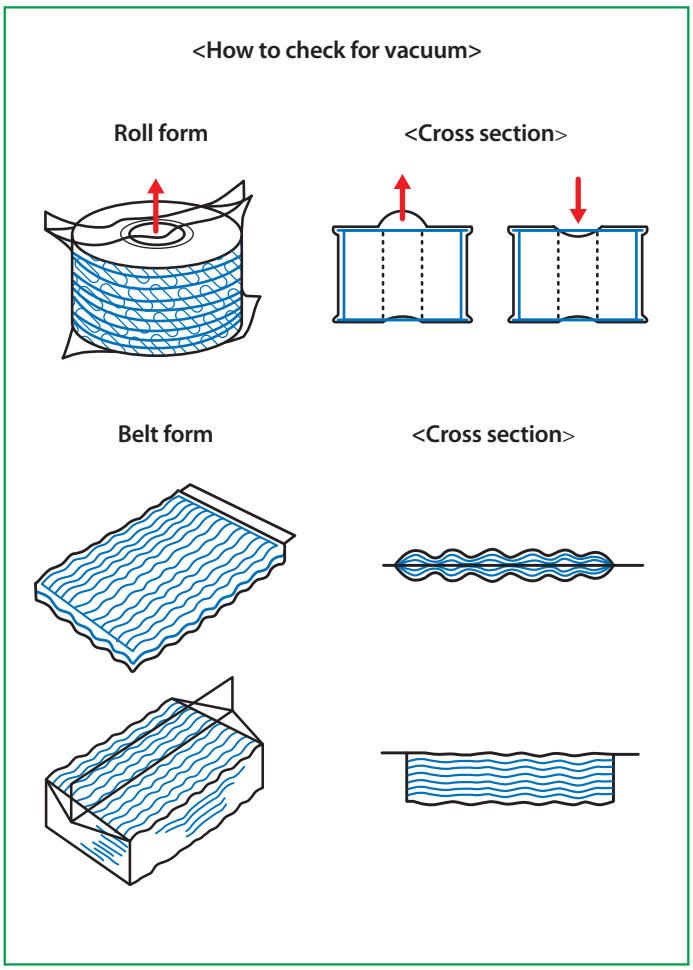
The product is packed in a vacuum packed external packaging to prevent permeation by oxygen. By checking the condition of the vacuum, minute pin-hole created during transport or handling, as well as damage to the master bag can be checked.
We will replace AGELESS whose vacuum of the outer bag is lost when the carton box is unpacked. Contact our distributor.

How to check for vacuum of roll form

- Check that the paper core cap hole in the master bag is pressed inward.
- Pull out the master bag that is pressed inward within the paper core cap hole and check that it returns to normal when released (even if it returns slowly it is correct).

How to check for vacuum of belt form

- Check that the master bag is bumpy along the belt upper surface.
- Contact us if a vacuum cannot be determined using this method.



How to use AGELESS®

Discard one each of the first and the last piece of AGELESS in continuous rolls without using because labels and tapes are affixed.

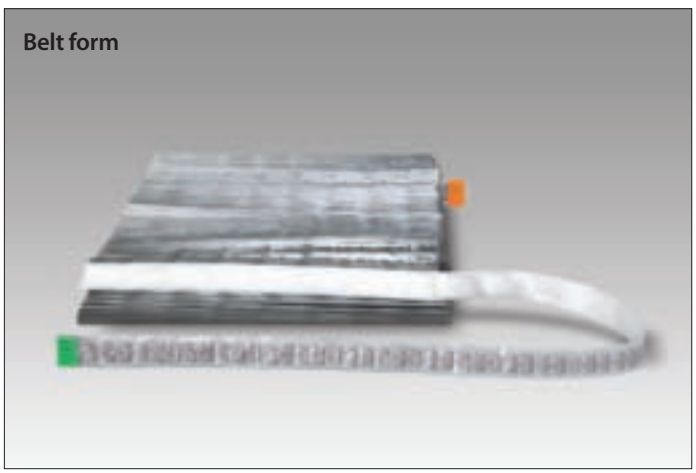
Water dependent type

AGELESS® in belt form (FX-B type)

Totally cut open one side of the master bag before use. See page 8 for handling time to open Air. Return remaining AGELESS after use to the original master bag, expel air as much as possible, and hermetically seal the master bag by heat sealing or by the use of AGELESS clip.

AGELESS® in continuous roll form (FX-LR)

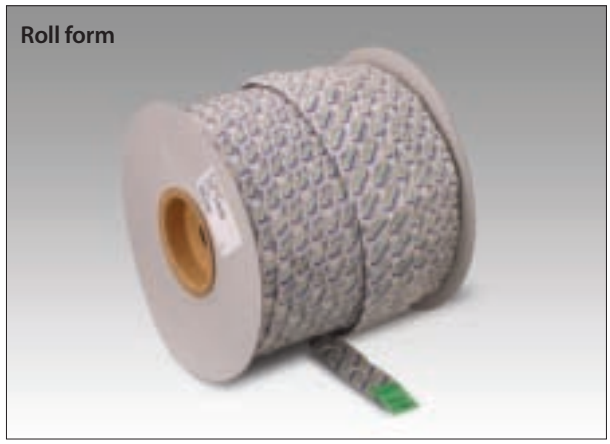
Totally cut open one side of the master bag before use. See page 8 for handling time to open Air. Return remaining AGELESS after use to the original master bag, expel air as much as possible, and hermetically seal the master bag by heat sealing or by the use of AGELESS clip.



Self-reacting type

Roll form (1) (ZP-R, ZPT-R, Z-PTR, Z-PKR, SA-R, GLS-R, GE-R)
Use these products at a rate of 1,000 sachets per hour.
Calculate total working time using the following formula including 30 minutes for setting etc.

(Number of sachets in the roll/ 1,000) hours + 0.5 hours or less
(Example: In the case of 3,000 sachets rolled, total working time is 3.5 hours)
If you stop the production, longer than 1 hour, put AGELESS in a master bag.



Roll form (2) (Z-PR, E-R type)
Be sure to dispose of the first sachet and the last sachet of each roll, not using them, due to the properties of the roll product.
Also, be sure to dispose of the first sachet when resuming the use of an opened roll.
Calculate total working time using the following formula.
(Note: On the roll types of Z-PK, size 20 and 30 types are indicated as Z-PR)

- A roll containing 6,000 sachets or more
  (Number of sachets in the roll/ 1,000) hours + 0.5 hours or less
- A roll containing less than 6,000 sachets
  6 hours or less

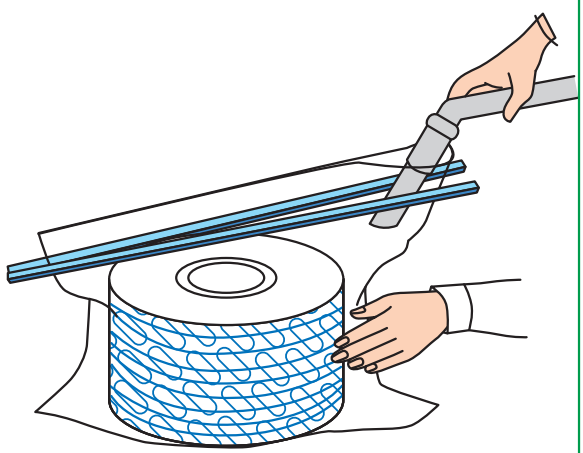
How to keep opened rolls

- Vacuum-pack the remaining roll with a vacuum cleaner or otherwise to keep it.

Method of vacuum-packing

- Seal one side of a bag with a heat sealer, and vacuum the bag by putting the cleaner nozzle (cleaning nozzle) into the bag from the open end, and seal the open end quickly after removing the nozzle.
- Be careful not to make wrinkles at the sealed ends of the bag.
- If sealing with a heat sealer is difficult, AGELESS Clip may be used for sealing, as shown on the right. Sealing will be insufficient if the clip is loose. In such case, use a new clip.
- In either case, check the vacuum condition when resuming the use of the roll in the bag.
- When keeping the roll form (2) (Z-PR, E-R) for 24 hours or more, put in a self-reacting type AGELESS comparable to SA-500 or above, and then vacuum-pack it for keeping.
- When a small amount of sachets of a roll type product remains near the roll core, remove them from the core and vacuum-pack them for keeping.
- Roll keeping bag No. 2 may also be available.
  See p. 29.

<How to keep a remaining roll form>



AGELESS® Usage Precautions

Warning

AGELESS® suppresses growth of microorganisms

AGELESS effectively suppresses the growth of molds and other aerobic microorganisms. However, it does not suppress obligatory anaerobes, microaerophiles, facultative anaerobes and yeast. Before using AGELESS in food packages that are susceptible to these microorganisms, it is necessary to conduct tests under the actual packing and distribution conditions. Combined use of AGELESS with refrigeration and other food preserving methods is recommended. (Note that the growth of mold cannot be fully prevented by AGELESS under certain packaging conditions.)

*Note that the growth of mold cannot be fully prevented by AGELESS under certain packaging conditions.

Precautions for AGELESS®

Further precautions

Be sure to read the AGELESS Users' Manual before using any of the AGELESS products. Most AGELESS has water, oil, alcohol and acid resistance, but these resistances are limited. It is recommended that every user conduct AGELESS tests under actual usage conditions to verify its effectiveness.

*AGELESS is an odorless material that is not meant to be eaten. Unlike most food preservatives, AGELESS is not mixed into food.

Rust formation when iron-based AGELESS® is used

In the case of acidic products or products with alcohol or a pH adjuster, etc., rust may be generated from AGELESS sachet. Before use, please test your products with AGELESS under actual production condition and be sure to confirm rust generation. In addition, rust may be generated when AGELESS is placed under excess air (capacity shortage, when low barrier performance packing material is used, pinholes, seal defect, etc.).

Heat generation

Upon opening a food package containing AGELESS, the rapid oxidation of AGELESS may generate heat. However, the amount of heat generated is moderate, insufficient to cause ignition or generally insufficient to cause burns. The temperature and the amount of heat generated and the time following exposure to the air required for heat generation depend upon the type of AGELESS and the conditions of packaging.

Use in Microwave Ovens

Remove AGELESS when heating any food package containing AGELESS. If AGELESS is microwaved, it might spark, scorch the package, and, on rare occasions, ignite. If AGELESS is likely to be microwaved with food, it is necessary to include precautions to prevent heating of AGELESS.

Discoloration of food with AGELESS®

AGELESS inserted in packages of raw meat, redfish meat, processed squid, and Chinese noodles may discolor such food items. Conduct tests before using AGELESS under actual packaging conditions. For persistent discoloration problems, contact our sales representative.

Safety of AGELESS®

Products: AGELESS®, AGELESS-EYE®

The main constituents of oxygen absorber AGELESS include iron powder and vitamin C, while the main constituents of oxygen indicator AGELESS-EYE include inorganic salts and colorants. These constituents have been confirmed to be safe in acute toxicity tests by official institutions such as Springborn Institute of Bioresearch Inc., United States Testing Company and Japan Food Research Laboratories. (LD50 Value of the contents of AGELESS is safer than salt)

The packing materials used in AGELESS and AGELESS-EYE have passed the standard regulations for food containers, plates and packing set out by the Japanese Ministry of Health and Welfare Notice 370 issued in 1959 and Notice 20 issued in 1982 as a material that may come in direct contact with foodstuff.

In addition, some packaging materials meet CFR-21 regulation.

* If you need specific safety test data, please contact us.

Some types of AGELESS comply with FDA and EU-Directive.
For more information, please ask our sales offices.

First aid measures

What if the powder in AGELESS comes into contact with my eyes?
Rubbing you eyes may cause scarring. Wash with plenty of water and seek medical attention.

What if a sachet of AGELESS (AGELESS-EYE) is swallowed whole?
It may damage the esophagus or digestive organs. Seek medical attention.

What if the powder in AGELESS comes into contact with my skin?
Wash the skin well with soapy water or water.

What if the powder in AGELESS accidentally enters my mouth?
Rinse your mouth with water.

In case of fire

Contents of the product are both combustible and noncombustible.
Packaging material is combustible.
No particular firefighting measures are suggested for fires involving the product.

Disposal considerations

After use, discard AGELESS through ordinary disposal methods, with no special treatment required. The packaging material of AGELESS is made from plastic film that includes paper. The product should be disposed of in accordance with the municipal regulations.

Storage considerations

Take care not to expose the carton box to water and not to break the master bag. Avoid handling the product roughly. See pp.10 and 17 for the method of keeping the product without impairing quality.

Entry data, evaluation results

All the information contained herein is based on the reference materials, data and information available as of the date issued. Warnings and cautions stated herein are based on the product handling under normal conditions. If it is handled under special conditions, safety evaluation and measures should be taken anew in accordance with the application or usage.

Examples of caution statements for AGELESS®

Please refer to the following examples of caution statements for products adopting AGELESS considering the characteristics and distribution conditions of your product.
According to an FDA opinion, "There would be no objection to inclusion in packages of food of the oxygen-absorbing sachets…". They believe "it would be advisable to inform the consumer of the presence of the oxygen-absorbing sachets by labeling on the outside of the food package…".

Items	Example statements
Statement concerning the purpose of using AGELESS®	• Oxygen absorber AGELESS® absorbs oxygen in packages and serves to keep the food fresh. • Oxygen absorber AGELESS® is used to keep the food fresh.
Statement for preventing accidental ingestion of AGELESS®	• Oxygen absorber AGELESS® contained is not edible.
Statement concerning heat generation of AGELESS®	• When opening the product, oxygen absorber AGELESS® contained therein may become hot but no worries about fire. Please dispose as it is.
Statement concerning microwave oven	• Oxygen absorber AGELESS® contained in the food container must be removed before warming in a microwave oven.
Statement concerning reuse	• Oxygen absorber AGELESS® cannot be reused.
Statement concerning disposal	• The packaging material of AGELESS® is made from plastic film that includes paper. The product should be disposed of in accordance with the municipal regulations.

Microorganisms

Microorganism growth inhibition by AGELESS®

The oxygen absorber AGELESS inhibits the growth of molds and other aerobic microorganisms, but does not inhibit the growth of obligate anaerobes, microaerophiles, facultative anaerobes, or yeasts. The use of AGELESS with food products that are preferable to these microorganisms is carried out at your own risk; it is recommended that you conduct tests under actual packaging and distribution conditions, and design a method appropriate to your application, such as combined use with other food preserving methods (e.g., refrigeration). (Note that the growth of some kinds of mold cannot be fully prevented by AGELESS under certain packaging conditions: (see the following data.)

Microorganisms are closely associated with the decomposition and denaturalation of food.
Therefore, when using AGELESS as a method of prevention, it is necessary to be aware of the various kinds of microorganisms, their growth conditions and other characteristics, and the methods for suppressing their growth. Measures must also be in place to prevent fermentation and spoilage.

Kinds of Microorganisms and the effect of AGELESS®

Kinds of microorganism		Common microorganisms	Food poisoning microorganisms	Characteristics	Comfortable suitable Aw range for growth	Effects of AGELESS
Aerobic microorganisms	Mold	Aspergillus Penicillium	Aflatoxin-producing molds	Unable to grow in anaerobic conditions	0.80 or more	AGELESS markedly inhibits growth
	Aerobic bacteria	Many Bacillus Pseudomonas				
Common yeasts		Bread yeast Alcohol yeast		Grows well in aerobic conditions, but able to grow in low oxygen concentrations as well	0.80 or more	AGELESS cannot sufficiently inhibit growth
Facultative anaerobes		E. coli	Staphylococcus aureus Vibrio parahoemolyticus Pathogenic E. coli (e.g., O157)	Grows well in aerobic conditions, but able to grow in anaerobic conditions as well	0.90 or more	AGELESS cannot inhibit growth
Microaerophiles		Most of lactic acid bacteria	Campylobacter	Grows best in low oxygen concentrations		
Obligate anaerobes		Bifidobacterium	Clostridium botulinum Clostridium perfringens	Grows in anaerobic conditions		

"Food poisoning microorganisms" are such microorganisms that directly cause adverse effects on the human body. However, other microorganisms, such as some molds, cause adverse effects on the human body through the production of toxins. "Common microorganism" do not directly cause adverse effects on the human body, but promote food decomposition. Inhibition of microorganisms, including the growth of common microorganisms, is important to maintain the freshness of food.

Microorganism growth conditions and preventing method

Microorganism growth conditions In general, for microorganism growth, the following conditions are involved.		Means for preventing fermentation and putrefaction
Nutrients	Microorganisms are unable to grow unless nutrients exist. Foods are nutrients themselves, and must be kept in the state free of contamination by microorganisms.	Keep the manufacturing environment clean (remove nutrients necessary for microorganism growth). ・Perform disinfection and sterilization treatment. Disinfect and sterilize material, equipment, apparatus, containers, and wastes by the methods that comply with objects so that they do not serve as a source of microorganism growth. ・Perform anti-pollution treatment on manufacturing facilities, manufacturing workers, air, etc.
Moisture content (water activity)	Microorganisms are unable to grow without moisture (see the relationship between the kind of microorganisms and AGELESS).	Lower the water activity. (Reduce the ratio of free water which microorganisms could use.) ・Increase salt concentration and sugar content. ・Lower moisture content.
pH	Growth of microorganisms is active where pH is around 7.0 (neutral).	Adjust pH. Lowering pH (acidic) or increasing pH (alkaline) makes microorganism difficult to grow.
Temperature	Microorganisms, in general, grow actively at 20 to 30°C.Excessively high temperature or low temperature kills microorganisms and makes it difficult to grow.	Heat-treat.
		Store or distribute products refrigerated or frozen.

In order to prevent fermentation and putrefaction, identify whether the fermentation or putrefaction is caused by primary contamination arising from materials, etc., secondary contamination by settle plate bacteria, adherent bacteria, etc., or by food properties, and then, take actions.

Precautions to be observed when using AGELESS®

The following precautions are necessary to prevent microorganism growth when AGELESS is used for food with a water activity of 0.80 or higher.

(1) The expiration date of the food should be decided by tests using the actual packaging, in order to verify the effectiveness of AGELESS. Please set an expiration date with an appropriate margin, considering an expiration date obtained without the use of AGELESS as a reference.

(2) In production of high-moisture foods, with a water activity of 0.90 or higher, it is important to prevent microorganisms from starting the growth process. Maintain a clean production environment.

(3) For food that is stored and distributed at low temperatures, continue to use the same storage and distribution conditions when used with AGELESS.

(4) If food ingredients are changed, and particularly if water activity has increased, a new set of confirmation tests using AGELESS must be performed. Storage and distribution methods must be reevaluated as well.

(5) If mold (particularly colored spots of mold) has appeared despite the use of AGELESS and the absence of pinholes, reevaluate the gas barrier properties of the packaging material.

Sanitary control of food-production processing

The following sanitary controls must be practiced during the food-production process, regardless of the use of AGELESS.

(1) When resuming the use of production facilities and equipment idled for an extended period, perform a thorough cleaning and disinfection.

(2) Do not open the windows of food production and packaging rooms, even if the room temperature is high.

(3) Vigilance is required in spite of heat-processing, as some microorganisms are highly resistant to high-temperature conditions. Ensure that heat-treatment has been properly carried out.

(4) If food becomes spoiled or fermented despite having undergone heat-processing, examine the heat resistance of the causative microorganisms. If the causative microorganisms show resistance, determine whether the ingredients are contaminated with those microorganisms and take any necessary steps. For microorganisms that do not show resistance, improve the sanitation of the cooling and packaging processes performed following heating processes.

(5) High-moisture ingredients should be used within one day and not saved for the following day. If the ingredients must be saved, store them in a refrigerated or frozen state.

Prevention of botulism

Food poisoning caused by C.botulinum bacteria is highly lethal and must be prevented at all costs. Generally, botulism can be prevented by fulfilling one of the conditions given in Figure 1. Maintain strict control of sanitation to guard against unforeseen circumstances.

Figure 1

- No contamination of C.botulinum to ingredients during production and distribution.
- Storage and distribution temperatures of 3°C or lower, at which temperatures the bacteria cannot propagate.
- Heat-disinfection with temperatures of 100°C at the food core for at least 6 hours or at 120°C for at least 4 minutes.
- Food characteristics that do not permit growth of C.botulinum: set uniform conditions of water activity of 0.92 or lower (salt concentration ≤ 12%, sugar concentration ≤ 55%) and pH of 4.5 or lower or 9.1 or higher.
- Detoxification of toxins produced by C.botulinum by heating the core of food to 80°C for at least 20 minutes or to 100°C for at least 2 to 3 minutes.
- To develop procedure for avoiding C.botulinum, please contact your own commercial or industrial association, or local health service for specific procedures and applicability to any particular product.

With respect to measures against Clostridium botulinum poisoning, in 2003, Ministry of Health, Labor and Welfare stipulated the following guidelines: **"Container packed foods whose pH exceeds 4.6 and at the same time, whose water activity exceeds 0.94 shall be sterilized by heating by performing autoclaved sterilization for 4 minutes at the temperature at cores of 120°C or by a method that has effect equivalent to or higher than this, or shall be stored at temperature not higher than 10°C."** When AGELESS is applied to foods that fall under this category, adequate attention must be exercised.

If you have any questions about the effects of AGELESS®, do not hesitate to contact your AGELESS® distributor or sales office.

AGELESS® Q&A

Q 1 Can AGELESS® be used in the frozen condition?

A. In the case of the freezing temperature of -25°C or lower, any type of AGELESS can be used. In this regard, however, the oxygen absorbing speed becomes extremely slow.
For example, at -20°C, it takes 3 to 4 weeks before the oxygen free condition is reached. Use AGELESS SS Type to bring the oxygen free condition in a short period (3 to 5 days) under the frozen condition up to -20°C.
In the case of other types, there is a method of keeping AGELESS at room temperature or refrigerated in half a day after being enclosed, and freezing thereafter.
In general, under freezing, the oxygen absorbing speed of AGELESS becomes slow but when the temperature returns to room temperature, the oxygen absorbing speed returns to the original speed.

Q 2 Can AGELESS® be used with vacuum packages?

A. Since the amount of air is already decreased in a vacuum package, a smaller size AGELESS can be selected. However, in the case of a strong vacuum ratio, place AGELESS into a free air-flow stream, with some distance between the product and the packaging film.

Q 3 Can AGELESS® be used with gas flushed packaging?

A. AGELESS can be used with the nitrogen gas flushing system. However, this combination will result in a slow rate of oxygen absorption due to the low initial oxygen concentration; therefore, select a larger size of AGELESS to compensate for the delay in oxygen absorption. In addition, gas flushing will tend to result in an imbalanced replacement rate; therefore, when using AGELESS with gas flushing, please use a size of AGELESS larger than the calculated size. Carbon dioxide gas replacement and mixed carbon dioxide-nitrogen gas replacement are not recommended for use with AGELESS, as carbon dioxide will inhibit the oxygen absorption of AGELESS.

Q 4 Can AGELESS® be used in combination with a desiccant?

A. Yes, it can. Use AGELESS Z-PK type (ZP type for large-size containers) which is powerful in the dry condition. In this regard, however, contact of AGELESS with a desiccant may degrade AGELESS performance. Insert AGELESS with care to avoid contacting.
In addition, use packaging material with high gas barrier capabilities.

Q 5 Can AGELESS® be used with high-temperature sterilization methods?

A. If AGELESS is used with high-moisture products in boiling or retort sterilization the AGELESS sachet may rupture, depending on the food characteristics, packaging form, and heating conditions, please make a test with the actual packaging material to judge the applicability of use.

Q 6 Will the deoxygenation rate be affected by the location in which AGELESS® is placed in the packaging?

A. Yes. Generally, AGELESS will eliminate oxygen more quickly when placed directly on the product. Even with self-reacting AGELESS types, deoxygenation will take longer when placed under the food tray than if placed on the product; therefore, application tests should be conducted with AGELESS placed at the chosen location under actual conditions.

Q 7 I use only a small quantity of AGELESS® at a time. Will opening and closing the master bag affect the performance of AGELESS?

A. Repeated opening and closing of the master bag is not desirable, as it will cause the AGELESS to repeatedly come into contact with air. We recommend that you divide the AGELESS into small quantities and place these in bags constructed from a high gas barrier material so as to reduce the frequency of contact between AGELESS and the atmosphere.

Q 8 We use AGELESS® for seasonal products. Can we use leftover AGELESS® for the next season?

A. The guarantee period of AGELESS is 6 months after the shipment.
This principle applies only to AGELESS kept in unopened outer bags (see page 17).

Q 9 Is AGELESS® safe even if AGELESS® is accidentally ingested?

A. AGELESS and AGELESS-EYE are not foods and are inedible, but the main components of AGELESS include iron powder, vitamin C, inorganic salts, colorants, and the like, and its safety is identified by the acute toxicity test conducted by public institutions.
When the powder, content of AGELESS, is accidentally eaten or cooked together with foods and eaten, no particular treatment is required if no particular abnormal symptoms develop. If any abnormal symptoms develop, get medical attention. This same principle applies to AGELESS-EYE, too. If a small sachet of AGELESS or AGELESS-EYE is swallowed in whole, the sachet may hurt the esophagus or digestive organs. Get medical attention (see page 22).

Q 10 Sometimes AGELESS® heats up during production packaging; is this normal?

A. If the master bag containing a self-reacting type of AGELESS is left open, or if the individual sachets are taken one by one from the master bag, heat generated from the reactions of AGELESS may accumulate in the bag, causing the bag to feel hot. Always spread out the sachets on a tray to avoid decreased performance. The roll and belt types may become hot during use, but this will not affect performance as long as they are used within the specified handling time.

Q 11 We had no problems in winter, but food spoilage occurred sooner when it became warmer.

A. In winter, the air temperature is low and the air is dry; consequently, the ability of microorganisms to propagate is reduced. The amount of microorganisms in the production environment and the initial number of viable bacteria are reduced, and microorganism growth during storage is suppressed; thus, food can be stored efficiently. However, when the weather is warm, microorganisms such as yeast and facultative anaerobes, which can grow in anaerobic conditions, will grow rapidly and may cause earlier food spoilage.
Generally, when AGELESS is used with food susceptible to the growth of mold and food spoilage, storage testing in winter alone is not sufficient. Please conduct storage testing of the actual packaging material again during seasons with higher air temperatures, reevaluate the type and size of AGELESS used, and set the expire date accordingly. Please note that AGELESS and other oxygen absorbers conduct are not effective in preventing spoilage due to anaerobic microorganisms. You should always carefully test your product to determine whether you have a problem with these organisms or not.

Q 12 When AGELESS® is used, products seem to be dried. Is this because AGELESS® absorbs the moisture content of foods?

A. AGELESS is not a desiccant. Self-reacting AGELESS contains the moisture in itself and does not absorb the product moisture content. Water-dependent AGELESS utilizes the moisture content in the atmosphere for reactions but not to an extent that may affect the food composition.

Q 13 AGELESS® of an appropriate size results in excessive shrinkage of the product. Is it possible to reduce the size of AGELESS®?

A. Even if the size of AGELESS is reduced, the amount of oxygen in air which AGELESS absorbs does not change. AGELESS is designed to exhibit its effect by keeping the container inside in the deoxidized state within an appropriate time. Using AGELESS of a size smaller than the appropriate size may delay the time for reaching the deoxidized state or causes oxygen to remain in containers and prevents AGELESS from exhibiting its intended performance successfully. For measures against product shrinkage, use a little bit larger bag, seal the bag with care to leave a slightly larger amount of air in the bag, or use gas purge packaging in combination.

Q 14 The AGELESS® packed food bag gradually swells within the sell-by date.

A. This may be attributed to carbon dioxide generated by food fermentation. Fermentation occurs by yeasts that can proliferate even under the deoxidized conditions and cannot be prevented by AGELESS (see page 23).

Q 15 Can AGELESS® be used for liquid products?

A. Liquid in an oxygen-permeable container can be stored with AGELESS in the oxygen-barrier outer package. Even dissolved oxygen can be absorbed by AGELESS through the container material after a while.
Note: AGELESS is not designed to be in direct contact with liquid.

List of terms

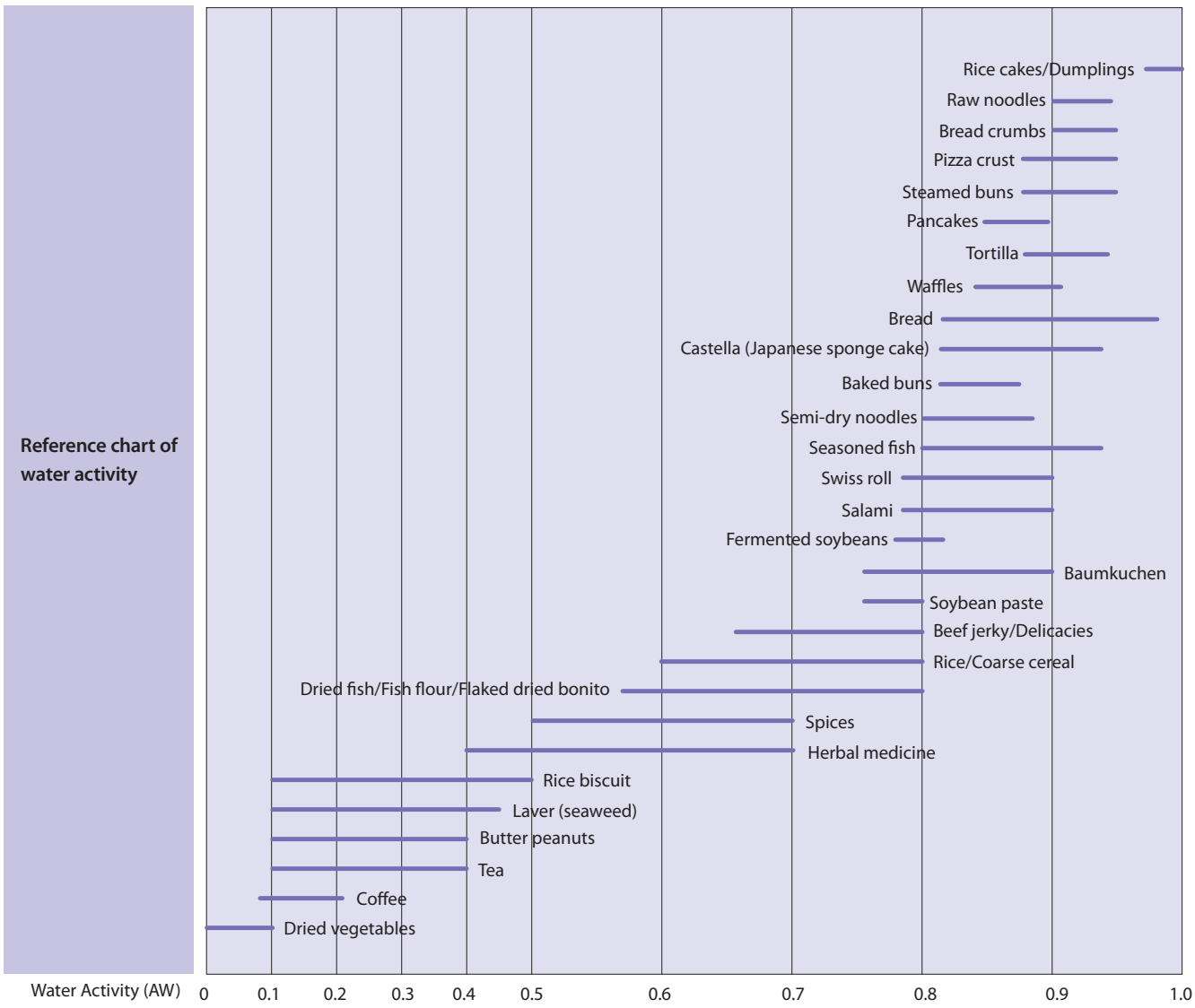
The meanings of some terms used in this instruction manual are as follows.

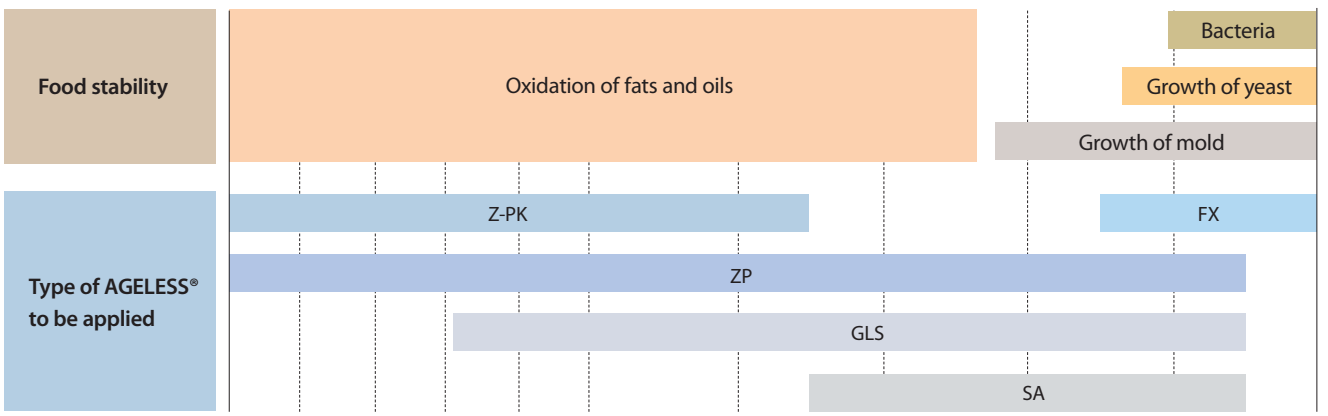
Acid resistance	When using AGELESS for an acid product, choose a type with acid resistance. Be sure to conduct a packing test since acid resistance is limited.
AGELESS Pack	Packaging of the application the inside of which is kept in the state of oxygen free using AGELESS.
Deoxygenation time	Standard number of days needed to attain the condition of oxygen free. Standard number of days needed to absorb the amount of oxygen absorption indicated in size under determined conditions. [Size 100 = the number of days needed to absorb 100 ml of oxygen] In actual packaging, the figure varies according to conditions such as the position of inserting AGELESS and the application of packaging.
Handling time	Standard time for which the product can be left exposed to the air after the master bag of AGELESS is opened. Handling time varies between loose form sachets and roll form or according to types of AGELESS. See p.8 for details.
Loose form	AGELESS separated into individual sachets, which can be used manually as they are.
Master bag	A sealed bag containing unused AGELESS. Material that has a high gas-barrier property or is unlikely to cause a pinhole is selected in order to keep quality. Master bag can also be used when keeping partially used AGELESS.
Material with a high gas-barrier property	Material that hardly allows oxygen or steam to pass through, such as film. Film of polyethylene or polypropylene is not available for free oxygen packaging since they easily allow oxygen to pass through.
O_2 absorption capacity	Amount of oxygen indicated by size. Oxygen absorber AGELESS is capable of absorbing the amount of oxygen thus indicated in a set number of days.
Oxygen free condition	A condition of maintaining an oxygen concentration of 0.1% or less due to the absorption of oxygen in the package by oxygen absorber AGELESS. This is realized through continuous absorption by AGELESS of even a small amount of oxygen penetrating through packaging material.
Packing test	A test of the applications packaged with AGELESS Pack in the condition of actual distribution.
Roll form	AGELESS for automatic inserters. There are roll type "R", in which sachets are rolled around a paper tube, and belt type "B", in which sachets are folded.
Size of AGELESS	A number indicating O_2 absorption capacity under determined conditions with ml, which serves a standard for choosing AGELESS with appropriate O_2 absorption capacity based on the amount of oxygen in the package. For example, if 500 ml of air is contained in a package, the amount of oxygen included therein is about 100 ml, so AGELESS of size 100 will be chosen. In the case of nitrogen gas replacement packaging, the replacement rate is taken into consideration. Note that the size of E-type and C-type represents the amount of carbon dioxide gas absorption.
Water Activity (AW)	Moisture in food consists of "absorbed water," which is combined with food constituents and "free water," which is not combined and available for microorganisms. Water activity is a standard indicating the content of free water. The higher water activity, the more likely microorganisms are to grow, so that the keeping quality of food deteriorates. Water activity is indicated in a figure between 0 and 1, e.g., water activity of food not containing moisture is 0 and pure water is 1. Correlation between water activity and moisture content is strong, but the water activities of foods with the same moisture content vary according to the content of salt or saccharide. Particularly, addition of salt is effective in lowering water activity. For example, when the water activity of a certain food is Aw, and the (equilibrium) relative humidity in the space where the food is sealed is RH (%), Aw = RH / 100. Water activity also serves a significant number in selecting a type of AGELESS.
Water activity of product to be applied (AW)	The scope of the water activities that serve a standard in selecting a type of AGELESS.
Water resistance / Oil resistance	When using AGELESS in direct contact with a high moisture / oil product, choose a type with water / oil resistance. Be sure to conduct a packing test since water / oil resistance is limited.

What is Water activity (AW)

Water Activity (AW) is the ratio water vapor pressure (p) generated by the product itself, to the maximum vapor pressure (Po) at a given temperature. It is also shown by the balanced relative humidity (RH%) generated by moisture transpired from the product when it is packed in a closed container.

$$AW = \frac{P}{Po} = \frac{RH(\%)}{100}$$



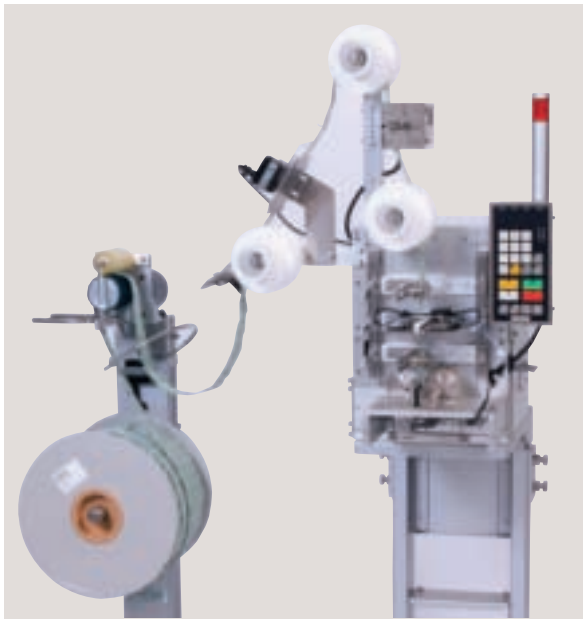


AGELESS® Peripherals

For the more versatile use of AGELESS® products

(The product is excluded from the ISO9001 quality control/assurance systems, because they are not manufactured by MGC.)

AGELESS® automatic insertion machine



When connected to an automatic packing machine, pieces of AGELESS are cut from a roll and inserted one at a time. Its compact design means it can be installed and connected to existing packing machines.

AGELESS® automatic adhesive machine

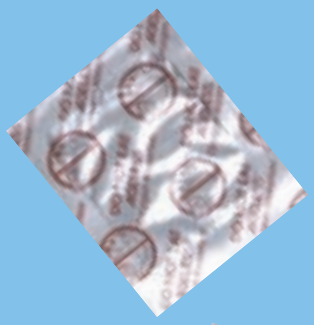
The machine affixes double-coated adhesive tape to AGELESS both packed in continuous rolls. The machine cuts the AGELESS and tape one by one in linkage with a packaging machine and fixes AGELESS to the inner surface of packaging film or top film of trays. There is also adhesive system using hot melt agent. The machine can prevent AGELESS from being accidentally ingested.

AGELESS® roll keeping bag No. 2

This bag is used to store the remaining AGELESS roll. With a zip seal, a vacuum cleaner can be used to remove air easily.

AGELESS® seal check

Check seal failure and pinholes.
One-touch spray type.



Applications of AGELESS®

Confectionary & Bakery Goods, Pizza, Pizza Crust, Nuts and Grains, Storage Foods (ex. Freeze Dry Product), Smoke and processed meat (Ham, Salami), Cheese, Coffee & Tea, Pharmaceutical / medical products, Supplement ...etc

AGELESS®

ISO 9001 REGISTERED FIRM
DNV Certification B.V.,THE NETHERLANDS

MITSUBISHI GAS CHEMICAL COMPANY,INC.

JAPAN — **MITSUBISHI GAS CHEMICAL COMPANY, INC.**
(Head Office)
Mitsubishi Building 5-2,
Marunouchi 2-chome
Chiyoda-ku, Tokyo 100-8324 Japan
TEL: +81-(0)3-3283-4842
FAX: +81-(0)3-3287-1785
email: AGELESS@mgc.co.jp
http://www.mgc.co.jp/eng/ageless/

U.S.A. — **MITSUBISHI GAS CHEMICAL AMERICA, INC.**
655 Third Avenue, 24th Floor
New York, NY 10017
TEL: +1-212-687-9030
FAX: +1-212-687-2810
email: AGELESS@mgc-a.com
http://www.agelessoxygenabsorbers.com

EUROPE — **MITSUBISHI GAS CHEMICAL EUROPE GMBH**
Immermannstrasse 13
40210 Dusserdolf, Germany
TEL: +49-(0)211-363080
FAX: +49-(0)211-354457
http: //www.mgc-europe.de

SINGAPORE — **MITSUBISHI GAS CHEMICAL SINGAPORE PTE LTD**
24 Raffles Place #16-01
Clifford Centre, Singapore 048621
TEL: +65-6224-0059
FAX: +65-6224-6079
e-mail: mgcsin@singnet.com.sg

SHANGHAI — **MITSUBISHI GAS CHEMICAL CO., INC. SHANGHAI OFFICE**
2110A, Westgate Mall, 1038 Nanjing Road(W),
Shanghai 200041,China
TEL: +86-21-62184081
FAX: +86-21-62184092
http://www.mgc.co.jp/chi/index.html

- The information contained herein is general and should not take the place of the users' own application tests. Recommendations are made without guarantee, and we must necessarily disclaim all liability with respect to the use of AGELESS®, supplied by MITSUBISHI GAS CHEMICAL COMPANY, INC. since the conditions of use are beyond our control.
- It is recommended that users of AGELESS® should carry out application tests with actual materials and equipment in typical operational circumstances.
- It is advisable, according to the FDA, to inform the consumer of the presence of the oxygen-absorbing sachets by labeling on the outside of the food package so that the consumer does not mistake AGELESS® as a food or as an ingredient.

2011.05