■WHAT'S SPLITSTAR® EXPANSIVE MORTAR?

SPLITSTAR® is the brand of our expansive mortar, it is a highly expansive powder composition for stone breaking, granite and marble quarrying, concrete cutting and demolition. **SPLITSTAR®** expansive mortar is safe, environment friendly is a good and viable alternative to explosives and other traditional methods of quarrying and demolition**. SPLITSTAR®** expansive mortar is mixed with clean water and poured into pre-drilled holes on rock and concrete. The diluted **SPLITSTAR®** expansive mortar swells and exerts significant expansive thrust on the hole-wall, fracturing the wall and splitting the rock across the line of the drill holes.

SPLITSTAR® expansive mortar are very easily split and fracture mass rock without producing any noise, vibration, toxic gases or flying debris. **SPLITSTAR®** expansive mortar is getting increasingly popular in quarrying and demolishing applications. expansive mortar can be used in a wide range of applications for safe demolition,concrete cutting, rock breaking and marble & granite quarrying.expansive mortar is particularly used for breaking, cutting or demolishing marble, granite and other natural stones, concrete and reinforced concrete.

Other **SPLITSTAR®** expansive mortar terminology reference,

Non-explosive Demolition Agent, Non-explosive Cracking Agent, Soundless (Silent, Noiseless) Cracking Agent (SCA), Expansive Demolition Agent, Expansive Agent, Expansive Mortar, Expansive Cracking Agent, Expansive Cement, Expansive Concrete, Chemical Rock Splitting
agent (HSA). Cracking Design Reference Chart.

■ADVANTAGES:

1. High range soundless cracking

SPLITSTAR® expansive mortar is a soundless, non-explosive and safe demolition agent which is quite different from ordinary demolition agents such as explosives and dangerous materials. It does not cause any fly rock, noise, ground vibration, gas, dust or any other environmental pollution when used properly. Eliminates noise, fly rock and vibration potential caused by blasting or heavy mechanical means.

2. No license required

Using **SPLITSTAR®** expansive mortar does not require a special license unlike explosives, chemicals and so on.

3. Rapid usability

Since rock or concrete previously cracked with **SPLITSTAR®** expansive mortar is easily broken with breakers etc., the amount of time required for breaking of rock or concrete can be remarkably reduced.

4. Simple to use mixed

SPLITSTAR® expansive mortar with a measured quantity of water and poured into the holes. Few minutes after pouring a reaction of hydration is taking place generating heat and crystallizing and expanding while hardening. If hydration takes place under confinement, significant expansive pressure will result, No need for detonator, ignition and professional operators. also demolition work in water is possible.

■COMPARISON OF DEMOLITION METHODS

There are many superior points in the demolition work performed by " **SPLITSTAR**® expansive mortar " as compared with the other demolition methods. It is also seen to be more economical.

Kinds	Breaking power	situations at the work site				Safety	Simplification of protection*	Economy*
		Noise	Ground vibration	Dust gas	flyrock			
Explosives(Dynamite)	●	×	×	×	×	×	×	●
Explosives (Concrete cracker)	◎	△	△	×	△	△	×	◎
Rock breaker	△	△	◎	◎	●	◎	●	△
Hydraulic splitter	◎	●	●	●	●	●	●	×
SPLITSTAR®	◎	●	●	●	●	●	●	◎

●Superior (or pollution-free) ◎Good △A little infenior × Inferior (or with pollution)

*Results differ subject to the circumstances.

■USES OF SPLITSTAR® EXPANSIVE MORTAR

Since **SPLITSTAR**® demolishes objects by expansive stress, it is used for various purposes. In particular, **SPLITSTAR**® is very suitable for demolition work in tight quarters where large-sized breaking machines or explosives cannot be used due to their causing environmental problems.

※Stone&Rock



stone cutting, removing boulders

Slabbing

Excavation of rock wall or bedrock

1.for road expansion

2.for harbour expansion

3.for residential development

4.for various types of construction work etc

Excavation associated with tunneling

Trenching,Shaft sinking

Quarrying

Others

※Concrete


Demolition of mass concrete

Demolition of foundations for machinery and structures

Demolition of pillar, beam, wall or slab of bridges
Demolition of temporary concrete structures
Demolition of piers
Demolition of retaining wall
Partial demolition of various concrete structures

※Others

Demolition of fire-bricks
Demolition of bricks for structures

■PROPERTIES

※Chemical compositions of SPLITSTAR® expansive mortar

It appears to be grayish white powder and be composed of multi-structured inorganic particles. There is no content of any harmful composition. **SPLITSTAR®** is a powder product consisting of calcium oxide and an organic material.

• Chemical compostion report(%)

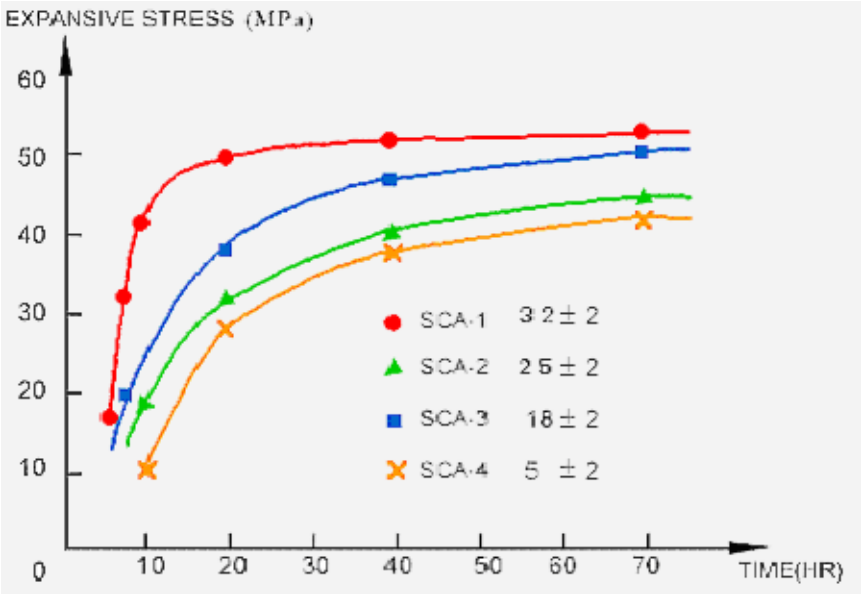
SiO2	A12O3	Fe2O3	CaO	Total
5.1	1.6	2.5	89.6	98.8

※Some effeects on the expansive stress of SPLITSTAR®

1. The expansive stress increases more than 30 N/mm^2.Generally, the compressive fracture stress of rock is 100 to 200 N/mm^2 and that of concrete is 15 to 50 N/mm^2. However, the tensile fracture stress is very small, for instance, it ranges from 4 to 7 N/mm^2 in rock and 1.5 to 3 N/mm^2 in concrete. Since demolition with **SPLITSTAR®** is based on a fracture due to a tensile stress, all kinds of rock and concrete can be cracked and broken with **SPLITSTAR®** when appropriate holes are properly drilled.

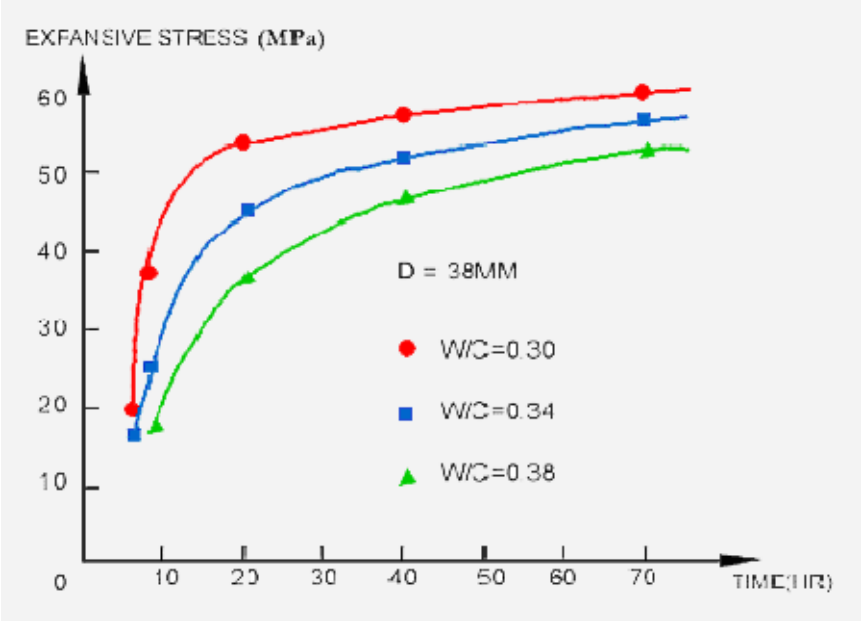
2. The larger the hole diameter is, the greater the expansive stress becomes.
3. There is little change in the expansive stress when the water ratio is in the neighborhood of approximately 30%. However, the stress is decreased as the water ratio is increased or decreased.
4. The expansive stress along the hole depth is almost constant except for that near the entrance of holes. Generally, the expansive loss from the hole entrance has little effect on the demolition work when the hole depth is enough.
5. When **SPLITSTAR®** is properly used within the parameters as noted in the conditions, no spurt due to heat generation (blown-out shot) occurs, because of the **SPLITSTAR®**'s strong adhesion and frictional resistance to the upper surface of the hole.

1• The expansive stress reach maximum value in about 24 hours of reaction.

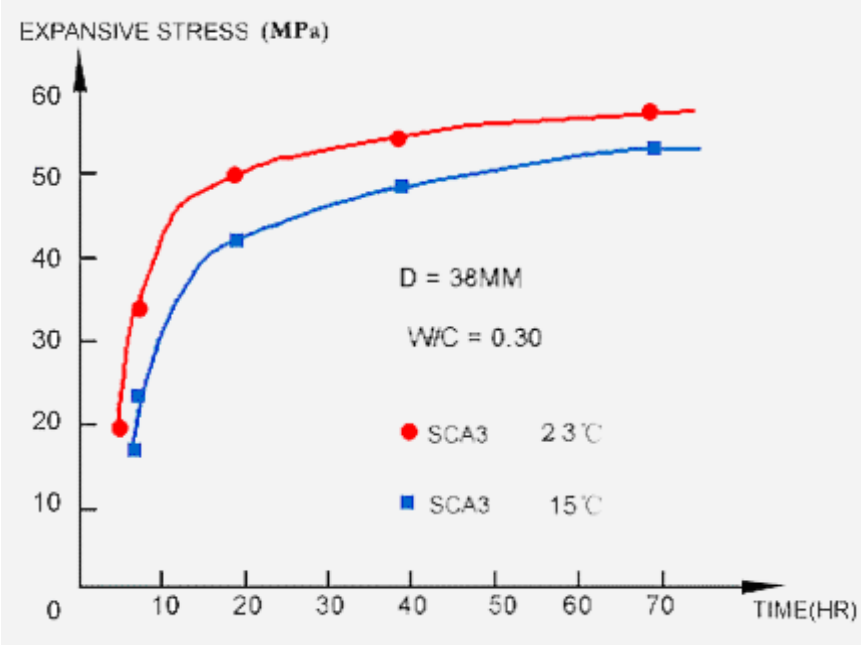


However, it still increases afterwards.

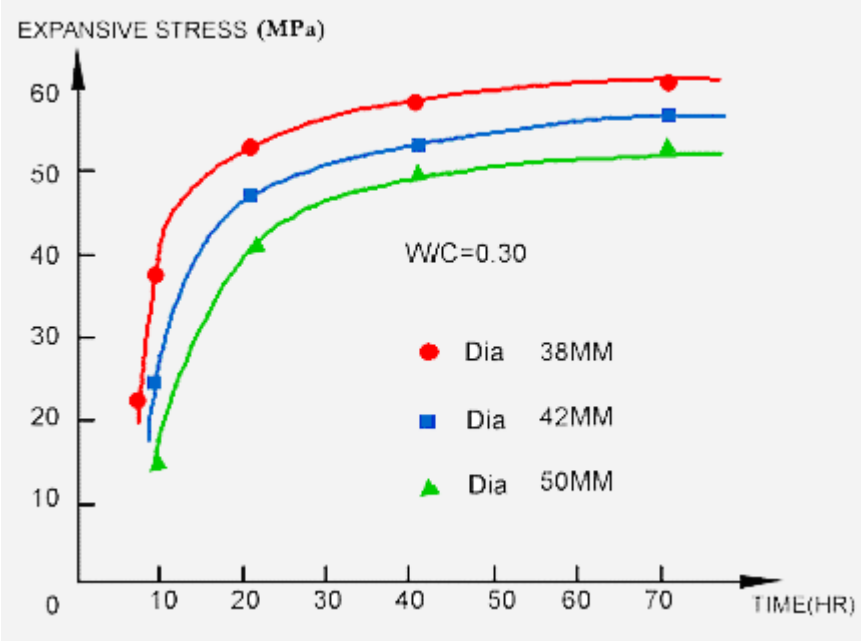
2• the expansive stress would decrease if water ratio increases.



3• The expansive stress would grow up with rising temperature.



4• The expansive stress would be higher if the diameter of pre-drilled hole is bigger.



■FRACTURE MECHANISM

After **SPLITSTAR**® expansive mortar is poured into holes drilled in rocks or concrete, the expansive stress gradually increases with time, and reaches to more than 50Mpa equal to 6000 mt/m^2 at room temperature after 5 hours. As the **SPLITSTAR**® generates its expansive stress, the material to be cracked undergoes a

process of (1) crack initiation, (2) crack propagation, (3) the increase of crack width. Therefore, this fracture mechanism is distinguished from a breakage by blasting.

The mechanism by the expansive stress of **SPLITSTAR®** expansive mortar is shown in Fig. 1. Cracks initiate from an inner surface of the hole, being caused by tensile stress at a right angle with the compressive stress which occurs by the expansive stress of **SPLITSTAR®** expansive mortar. The expansive stress of **SPLITSTAR®** expansive mortar continues even after the appearance of cracks, the cracks propagate and also new cracks initiate during the process. Usually, for a single hole, 2-4 cracks initiate and propagate. When a free surface exists, the crack, as shown in Fig. 2, is pushed apart mainly by the shear stress, and a secondary crack also arises from the bottom of the hole running toward the free surface.

Fig. 1 Fracture mechanism by the expansive stress of **SPLITSTAR®** expansive mortar

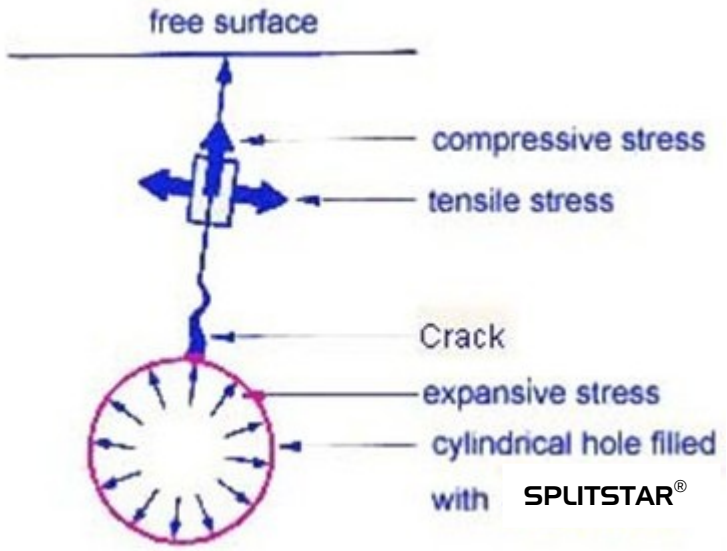
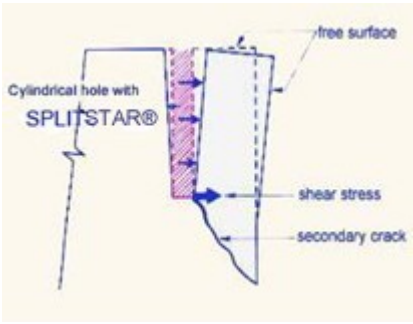
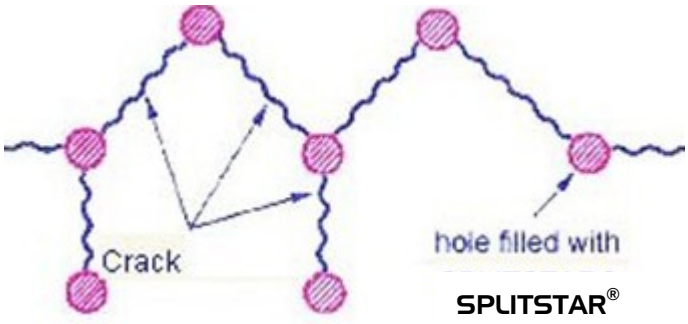


Fig. 2 Sectional-view of the crack formation in the material with two free surfaces



When multiple numbers of holes are filled with **SPLITSTAR®** expansive mortar, that are properly adjacent to each other, the cracks from the hole propagate to connect with the neighboring holes, as shown in Fig. 3.



It is therefore possible to determine the directions of the cracks as planned by appropriately arranging the hole spacing and its depth and its inclination.

Establishment of free surface:

In the case of trenching, shafting or tunneling, if all holes are drilled vertically and filled with **SPLITSTAR®** expansive mortar, the crack width can not increase but horizontal cracks initiate. Therefore, in order to obtain two free surfaces, inclined holes or pre-splitting must be required.

■TYPE OF SPLITSTAR® EXPANSIVE MORTAR

Type	Usable temperature
SCA-Ⅳ	40℃-50℃（104℉-122 ℉）
SCA-Ⅰ	25℃-40℃（77℉-104 ℉）
SCA-Ⅱ	10℃-25℃（50℉-77 ℉）
SCA-Ⅲ	-5℃-10℃（23℉-50 ℉）

SPLITSTAR® expansive mortar may blow out of the holes due to the heat generation when hole diameter exeeds 50mm(2inches) ir when **SPLITSTAR®** expansive mortar is used at temperatures over the above.

■PACKAGE:

SPLITSTAR® expansive mortar is packaged in 4 anti-moisture plastic bags of 5 kgs (11 lb) each , and the bags are placed in a carton box with a total net weight 20 kgs (44 lb). 50 carton/1 ton,1 tons per wood crate.



■STORAGE

1.Although **SPLITSTAR®** expansive mortar is packed in anti-moisture plastic bags, long storage may cause deterioration of its working ingredients. Therefore, store in a dry place and use it as soon as possible.

2.When storing**,** do not place the bags of **SPLITSTAR®** expansive mortar directly on floor, put them on a pallet and keep in a dry warehouse etc. **SPLITSTAR®** expansive mortar is stored in this manner, can be effectively used for about 1 year.

3. **SPLITSTAR®** expansive mortar should be unpacked before use.

4.When storing the portion of **SPLITSTAR®** expansive mortar remaining after use, push the air out of the bag, then seal with gum tape and use as soon as possible. However, as it may get exposed to moisture there is a risk of **SPLITSTAR®** expansive mortar losing its effectiveness once the bag has been opened.

5.If you receive broken bags of **SPLITSTAR®** expansive mortar, they may not work due to chance of moisture absorption.

■ STANDARD QUANTITY

※Table 1: Pre-drilled hole design table

	Hole design		
Materails & purpose	Diameter(mm)	hole spacing	Depth
Soft stone quarrying	28-38	200-300mm	105% of height
Hard stone quarrying	30-40	200-300mm	105% of height
Stone cutting	28-38	200-400mm	90% of height
Plain concrete demoliton	30-40	300-500mm	80% of height
Reinforced concrete demolition	35-40	150-300mm	90% of height

※Table 2: Quantity of **SPLITSTAR®** used per hole length and hole diameters

Hole diameter(mm)	30	32	34	36	38	40	42	44	46	48	50
splitstar (kg/m)	1.2	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.8	3.0	3.2

5kgs of **SPLITSTAR®** is ususally used in case 1m^3 of virgin rock is demolished,for fragmentation and reinforced concrete,an amount 2 to 4 times that is required.

※Table 3:Quantity of splistar used per 1m^3.

Kinds of objects to be demolished			Standard quantity of **SPLITSTAR®** per 1m^3
Rocks	Soft rock		5-8kg
	Medium rock		8-12kg
	Hard rock		12-20kg
Concrete	Plain concrete		5-8kg
	Reinforced concrete	Concrete including less quantity of re-bars	10-25kg
		conrecte including much quantity of re-bars	20-35kg
Bricks			10-25kg

■HOW TO USE THE SPLITSTAR® EXPANSIVE MORTAR

a. Mixing: **SPLITSTAR®** expansive mortar is a powder that must be thoroughly mixed with clear water before used in a ratio of 30% of the overall weight (1.5 liters of each 5 kg packages). Gradually add the powder to water stirring all the time to obtain a smooth lump free mortar.

b. Filling: Pour the mortar into the prepared holes within 5 to 10 minutes only .Stope horizontal holes to allow an easy pouring of **SPLITSTAR®** expansive mortar (should some of the mortar leak out of hole. Stop it with a piece or soft sponge) or fill the holes with thick mortar of **SPLITSTAR®** expansive mortar,

c. Drilling : The distance between holes varies depending on the size of the hole (from 32 mm diam. to 42 mm diam.) and the type of materials to be demolished or cut. For rock or non-reinforced concrete should be 30 to 60 cm. And reinforced concrete should be 20 to 30 cm.

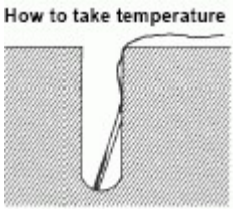
Selection of Proper Type of SPLITSTAR® expansive mortar

To avoid blown-out shots the proper type of **SPLITSTAR®** expansive mortar should be selected in accordance with the temperature of the object to be demolished. NOTE :When the season is shifting, ex. winter to spring, or when tunnel or underground demolition work is carried out, carefully select the proper type of **SPLITSTAR®** expansive mortar in accordance with the temperature of the object to be demolished, not outdoor temperature, because the temperature of the object is often great[y different from the outdoor temperature. If the temperature of the object is higher than the outdoor temperature and the type of SPLITSTAR selected in accordance with the outdoor temperature is used, blown-out shots will certainly occur.

Temperature Estimation

As shown in following picture, place a thermometer in the bottom of the hole and leave it in place for 2-3 minutes. Then quickly pull out the thermometer and take a reading.

NOTE :Avoid taking temperature right after drilling since the temperature of the hole is higher because of friction heat.



Drilling

Drill holes designed for demolition with a drilling machine.

(1) Drilling machine : Jack Hammer, Leg Hammer etc.

(2) Drilling Direction : It is preferable to drill holes vertically, but in case of a wall or pillar of reinforced concrete where vertical drilling is hard, an inclined hole may be drilled. For horizontal holes, the same idea of spacing as with vertical holes can be applied. Try to drill horizontal holes with some slope.

(3) Drilling machine : Use of Spiral Sheath Pipes

In the case of a temporary concrete structure (to be demolished), place spiral sheath pipes as holes before placing concrete. When the structure needs to be cracked, fill the holes with **SPLITSTAR®** expansive mortar after removing the spiral sheath pipes.

There is no change in breaking effect by the use of spiral sheath pipes. However, spiral sheath pipes of 36-50mm (1 3/8"-2") diameter should be used.

NOTE : Never use vinyl chloride pipes etc. instead of spiral sheath pipe. Leg Hammer Spiral Sheath Pipe

Jack hammer

Spiral Sheath Pipe

■SAFETY PRECAUTIONS

1. Wear safety goggles, rubber gloves, long sleeve cloth and helmet during **SPLITSTAR®** expansive mortar handling, mixing and filling.
2. Do not get your face close to or stand near filled holes for at least 3 hours after filling completion stop the hurt to eyes in case of blow out shots.
3. Wear a dust-proof mask when using **SPLITSTAR®** expansive mortar in poorly ventilated areas such as tunnels or mines.
4. Keep people away from job-site after filling mortar.

5. Skin contact with **SPLITSTAR®** expansive mortar must be rinsed off with large amounts of cold water immediately.
6. Should you get spray from **SPLITSTAR®** expansive mortar in your eyes, do not rub but wash the eyes immediately with plenty of cold water and consult doctor.

■APPLICATION EXAMPLE

Blocks extracting in quarry.


Demolition of concrete or reinforced
concrete objects

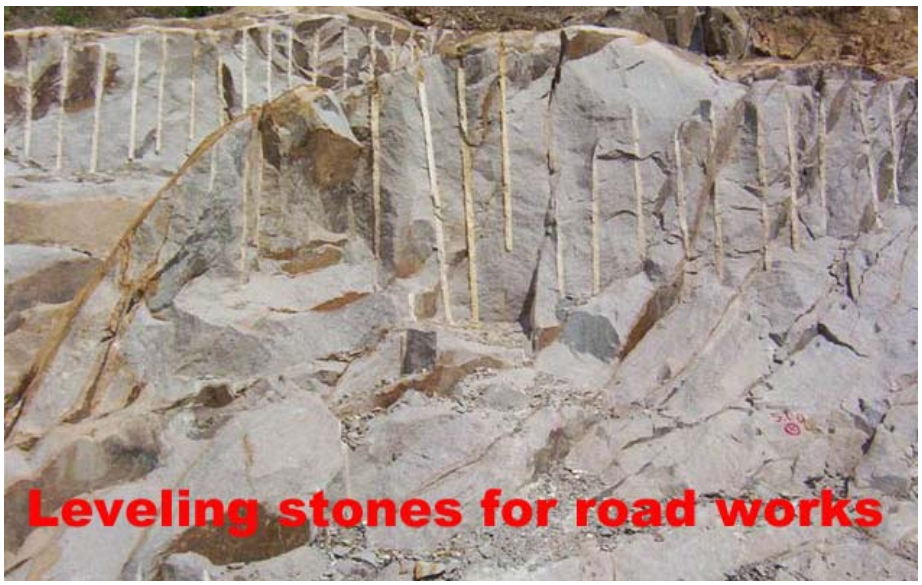
Reinforce concrete demoliton.

Water trenching


Excavating tunnel


Demolition of foundations


无声破碎剂应用典范：中国驻塞拉利昂使馆建馆工程（8）



■WARNING.

Do not use SPLITSTAR® for purposes other than cracking rocks or concrete as instructed in this brochure.

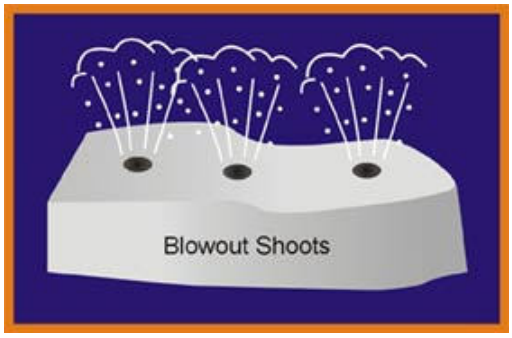
※To Prevent Blown-out Shots

1. Do not use **SPLITSTAR®** beyond the temperature range, hole diameter, water temperature and temperature of **SPLITSTAR®** as indicated in Table 2 on page 7.
2. Do not mix over one bag (5kgs,11lb.) of **SPLITSTAR®** with water at a time.
3. **SPLITSTAR®** mixed with water should be poured into holes within 10 minutes. (Do not leave **SPLITSTAR®** in a mixing container. Remaining **SPLITSTAR®** should be diluted with a great deal of water and then disposed of on open ground.)
4. Do not pour and leave **SPLITSTAR®** in glass containers. cans. etc.
5. Do not pour **SPLITSTAR®** into vinyl chloride pipes. (In case of demolishing a temporary concrete structure, be sure to use spiral sheath pipes.)
6. Do not tamp the entrance of the holes with sand, mortar or any other materials.
7. Do not tamp holes with a bar.
8. Do not use hot water.

※To Prevent Accidents Caused By Blown-out Shots

1. Always wear protective glasses,rubber gloves and hard hats during work.
2. Do not look into holes directly for at least 10 hours.
3. Do not stay near the holes for at least 10 hours after filling.
4. Cover the holes with a cloth or plastic sheet.
5. Forbid anyone to enter the job site after filling.
6. Wear a dust proof mask in case of using **SPLITSTAR®** in a closed area such as tunnel.
7. When any portion of the skin comes in contact with **SPLITSTAR®**, rinse it off with water immediately
8. When eyes come in contact with **SPLITSTAR®**, rinse them off with water immediately and consult an ophthalmologist.

※Blown-our Shot



A blown-out shot is that the **SPLITSTAR®** filled into a hole spurts out from the hole when it is not used properly(Refer to Picutre 1).

The blown-out shot occurs in succession 3-4 times after it occurs once, and it may occur in other holes. Therefore, do not rush to the field when the blown-out shot occurs.

SPLITSTAR® consists mainly of Calcium Oxide which is corrosive and is also a highly alkaline product. Loss of eye sight may occur if **SPLITSTAR®** comes.

KEEP OUT OF REACH OF CHILDREN

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