

# IXPER<sup>®</sup> Calcium Peroxide

## IXPER<sup>®</sup> Calcium Peroxide Products for Soil Amendment

Application Data Sheet



### Introduction

IXPER<sup>®</sup> 75C Calcium Peroxide is a fine, very pale yellow, odorless powder that consists primarily of calcium peroxide. The balance consists of calcium hydroxide and other inorganic fillers. IXPER 75C Calcium Peroxide is a time release source of oxygen that is Kosher certified and meets the Food Chemical Codex requirements for use in dough conditioning.

IXPER 70C Calcium Peroxide Granules is a pale yellow granule that has properties similar to IXPER 75C Calcium Peroxide except for an even slower oxygen release profile.

### Properties

IXPER 75C Calcium Peroxide is one of the most temperature stable inorganic peroxides. It decomposes at a temperature  $>370^{\circ}\text{C}$ . IXPER 75C Calcium Peroxide has the following typical characteristics:

Item	IXPER 75C	IXPER 70C
Appearance	Pale yellow powder	Pale yellow granules
Calcium Peroxide (%)	$78 \pm 2$	$72 \pm 2$
Available Oxygen (%)	$17.3 \pm 0.4$	$16 \pm 0.4$
Solubility in Water (20°C)	$<0.01\%$	$<0.01\%$

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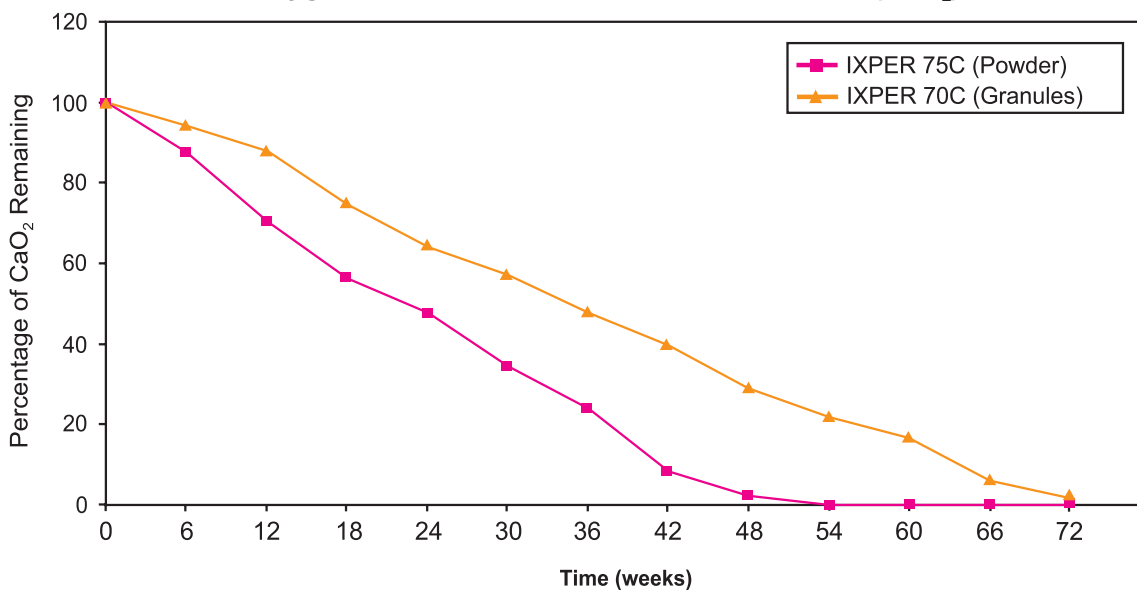
#### Effect of Moisture

IXPER Calcium Peroxide products are slightly soluble in water. The pH value of an IXPER 75C Calcium Peroxide suspension depends upon its concentration.

Concentration in slurry (%)	pH
0.5	8
0.2	11
1	11.7
10	12.7

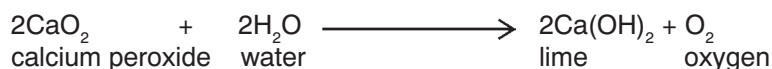
IXPER Calcium Peroxide products are a time release source of oxygen. The delayed release profile depends upon the surrounding medium such as moisture content, pH, temperature, metal impurities and turbulence, and can last for many months.

#### Slow Oxygen Release Profile of Calcium Peroxide (CaO<sub>2</sub>) in Water



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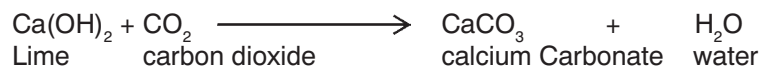
The product decomposes slowly in contact with atmospheric moisture or water, with the generation of oxygen and heat. Typically H<sub>2</sub>O<sub>2</sub> is not generated under these conditions due to the high pH.



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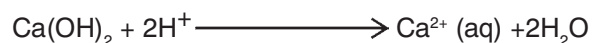
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In the presence of air, calcium hydroxide can react further with atmospheric carbon dioxide to give calcium carbonate.

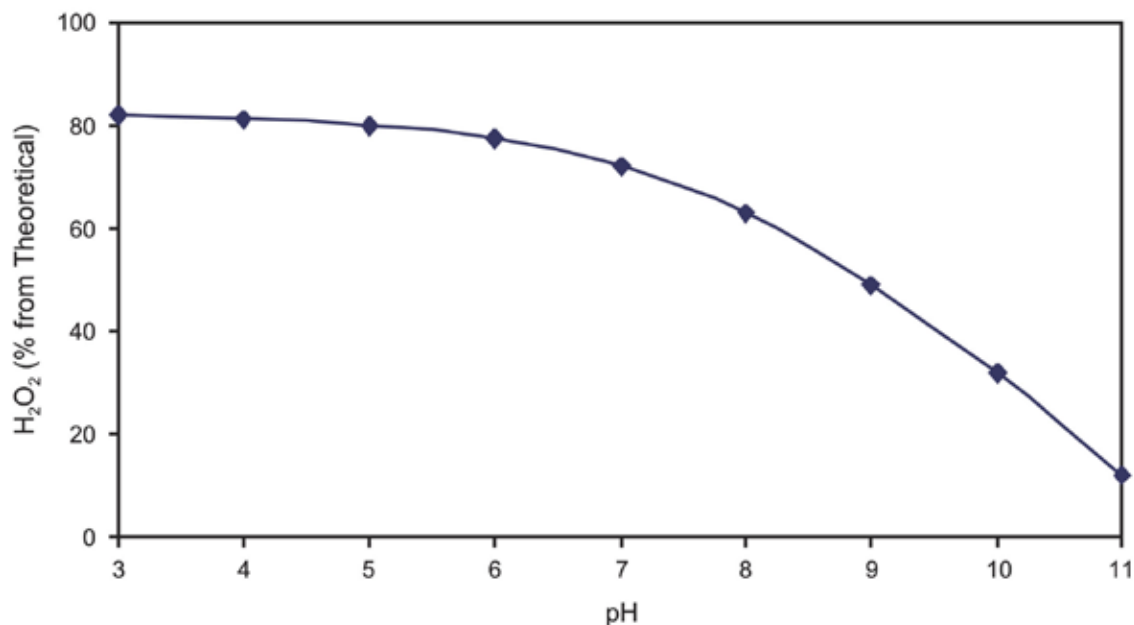


### Effect of Acids

In buffered systems with a pH substantially lower than 12, IXPER Calcium Peroxide products exhibit a different behavior. As the pH drops, the product becomes more soluble, and generates progressively higher ratios of hydrogen peroxide (active oxygen) to gaseous oxygen. Under acidic conditions, the available oxygen can be liberated within minutes.



The following graph was generated by adding sulfuric acid to a 0.2% slurry of IXPER 75C in water. After proper mixing, the slurry was immediately filtered, and the aqueous phase tested for its H<sub>2</sub>O<sub>2</sub> content. Additional acid was then added to the remaining slurry to reach a lower pH, and the process was repeated.

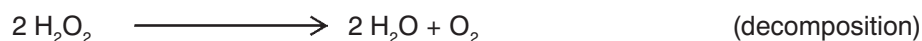
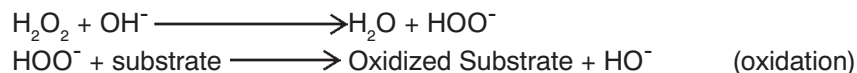


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It was observed that H<sub>2</sub>O<sub>2</sub> generation increased as the pH dropped. At pH 8, about 60% of the active oxygen content of IXPER 75C Calcium Peroxide was generated as H<sub>2</sub>O<sub>2</sub>. H<sub>2</sub>O<sub>2</sub> production leveled off at about pH 5.

The H<sub>2</sub>O<sub>2</sub> generated from acidified calcium peroxide slurries can further react in a variety of ways:



### Chemical Reactivity

The reactivity of IXPER 75C Calcium Peroxide is due to its ability to generate H<sub>2</sub>O<sub>2</sub> and oxygen.

- The H<sub>2</sub>O<sub>2</sub> released at lower pHs can be used for various oxidation reactions such as the degradation of organic products and polymers in soil remediation.
- The oxygen released can be used in a variety of applications including.
  - In soil and groundwater assisted natural attenuation of contaminants, it can maintain the aerobic conditions necessary to enhance biological activity.
  - In soil amendment, it provides the oxygen needed for seed germination and root growth.
  - In bodies of water, it can replenish dissolved oxygen.

### Applications in Soil Amendment

Plant roots need oxygen to function. Waterlogged soils occur due to heavy rainfall or bad irrigation techniques. For example, when rain guns are used on unstable soils, sand, silt or limestone, soils run together creating a seal that is impervious to oxygen and carbon dioxide.

In these cases, diffusion of gases through soil pores is so strongly inhibited that it fails to meet the needs of growing roots. Indeed, a slow oxygen influx was found to be the main reason of root injury.

In addition, flooding reduces the escape or oxidative breakdown of gases such as ethylene or carbon dioxide produced by roots and soil organisms. Accumulation of ethylene may slow root extension, and an excess of carbon dioxide in the soil can severely damage the roots of certain species. In addition, carbon dioxide can form bicarbonate ions that accentuate the effect of high lime in some soils leading to iron unavailability and chlorosis.

Typically, soils with ample supply of organic matter accelerate the development of these potentially harmful soil conditions due to the increased growth of microorganisms that decompose the organic matter leading to reduced oxygen availability in the soil. Crops growing at high temperatures or under a lot of sunshine also have very high oxygen demand at the roots.

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These conditions also lead to soil chemistry changes that are potentially harmful to the roots.

- In the absence of oxygen, microbial respiration can use alternate electron acceptors to sustain energy generation. This leads to a decrease in redox potential. For example nitrate is converted to nitrite, rendering nitrate unavailable to the plant. With an increase in the soil's reducing environment, oxides of  $Mn^{4+}$ , and  $Fe^{3+}$  are reduced to the highly soluble  $Mn^{2+}$ , and  $Fe^{2+}$  which might penetrate the roots and affect enzyme activity leading to membrane damage.
- Injury can also occur from chemically reduced metabolites such as organic acids and respiratory intermediates such as acetaldehyde.

Under these conditions, the lack of enough oxygen reduces root growth resulting in stunted growth, poor yields, lack of seed germination, etc.

Another issue is the development of mycorrhizas. They need well aerated soils and are inhibited by water logging and reducing conditions (Soil Conditions and Plant Growth 10th edition by E. W. Russell, Longman Group Limited 1973 p 253).



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IXPER Calcium Peroxide products would provide a time release supply of oxygen thus potentially reducing the negative impact of the conditions described above. They can be used for soil amendment in agricultural, horticultural and forestry applications. These products slowly decompose in the moist soil, generating oxygen and the corresponding hydroxide. This can have the following advantages:

- Modify the soil's biological activity as follows:
  - Increase total soil microbial population.
  - Enhance enzyme diversity.
  - Speed aerobic and biological activities at high moisture conditions.
  - Enhance the growth of symbiotic fungi that support healthy roots.
- Maintain and protect healthy plant roots.
- Improve the hydraulic conductivity of the soil allowing more efficient movement of oxygen and nutrients. This effect is especially useful in heavy soils.
- Give plants the ability to absorb more water and nutrients and use them more efficiently.

IXPER Calcium Peroxide products are also a source of calcium, which is an additional advantage in cases of calcium deficient soils.

#### Soil amendment

Because of the above properties, IXPER Calcium Peroxide is a good product for soil amendment. Its decomposition products, oxygen and slaked lime help improve the soil. Oxygen increases soil porosity and provides oxygen to the roots. The calcium hydroxide produced helps neutralize acid soil.

#### Seed germination

Germinating seeds are especially vulnerable to damage from waterlogging and the associated anaerobiosis and injury from chemically reduced metabolites such as organic acids and respiratory intermediates such as acetaldehyde. This is particularly prominent in cold, wet soil conditions in greenhouses.



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The advantages of seed coating with calcium peroxide could be due to the correction of the anaerobic conditions developed due to the breakdown of organic matter in the immediate vicinity of the seeds. It could also be due to the neutralization of any acidic and deleterious breakdown products. Coating seeds with IXPER 75C Calcium Peroxide can have the following advantages:

- Improved seedling anchorage to the soil reducing seed and seedling wind drift.
- Improved percentage emergence of seedling through both soil and water, leading to an increase of the number of emerging plants.
- Development of well rooted, vigorous, and uniform plants.
- Increased yields i.e. an increase in weights of individual plants.
- In case of rice, this allows the use of the “Continuous Flood” system where coated seeds are dropped into a flooded field that is maintained until near harvest. This system has the following advantages over the “Pinpoint Flood” system:
  - Easier water management and lower water utilization.
  - Less seedling stress from cool weather.
  - Reduction in seedling loss due to salt
  - Increased nitrogen efficiency, when nitrogen is applied to dry soil before flooding.

Examples of commercial seeds coated with calcium peroxide include rice, sugar beet, tomatoes, sunflower and grasses. Coated Lupin seeds have also shown a substantial increase in germination from waterlogged soil vs. uncoated seeds.

The coating level depends on the type of seed. For rice seeds, a coating level of ~20% w/w on seed weight was found suitable. Fillers or binding agents are usually incorporated in the coating. Coated seeds should be stored in a low moisture environment to avoid decomposition of calcium peroxide.

Alternatively IXPER Calcium Peroxide can be dusted to coat seeds or bulbs before planting. Either grade of IXPER Calcium Peroxide can also be incorporated in the soil to solve seed emergence problems. The latter approach was shown to be effective at improving crop emergence, dry matter, leaf area, and the grain yield of cowpeas grown in poorly drained soil.

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#### Tree transplanting

Transplanting seedlings in forestation, or 5 to 7 year old schools for park and lawn decoration is far from being 100% successful. Many trees die from "post operational shock".

The almost complete loss of its radicles, the transfer into an unfriendly, inhospitable environment and the lack of appropriate care in this period of heavy stress are very often fatal to the transplant. The valuable tree withers and dies.

Very often the lack of sufficient oxygen for the weakened root system in a compacted and/or waterlogged soil is the main cause of death. By ensuring that the rootball gets a steady and long lasting supply of oxygen the impact of transplanting is alleviated and the tree becomes well established.

Indeed IXPER Calcium Peroxide products may assist the tree to acclimatize more quickly by helping strong radicle development. This will lead to enhanced growth and may enable the tree to reach mature status earlier.



#### Field Trials with IXPER Calcium Peroxide Granules

A test was conducted at Iwaki City Fukushima Prefecture in July 1987 for 2 years using oak trees stripped of their leaves for transplanting. The trees were 2.5m high and 0.1m in diameter. No fertilizer was applied during the test period.

The test was done as follows:

- Dig a hole large enough to contain the rootball easily. For this test, the hole was 50cm in diameter and 40cm deep.
- Admix 300 to 1000g of IXPER Calcium Peroxide granules.
- Position the tree securely.
- Fill the hole with the IXPER Calcium Peroxide enriched soil.
- Firm the soil well.
- Water abundantly.



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The results clearly show that admixing of IXPER Calcium Peroxide granules with the soil is beneficial for the re-establishment of trees, even at low concentrations. This is true for low care planting conditions without special regimes of weeding and fertilizer application. See technical data sheet entitled IXPER Products for Tree Transplanting for details.

#### **Potted Plants**

Over-watering of house plants is often the main reason why ornamental plants do not grow well in homes. Indeed, frequent overwatering leads to compaction of the soil and a shortage of oxygen to the rootball.

IXPER Calcium peroxide products are a good source of oxygen for containerized plants. They can be mixed with potting soil prior to use at the rate of about one tablespoon per gallon of potting soil or 4 tablespoons per cubic foot. IXPER Calcium Peroxide should not be directly mixed with dry, granular fertilizers as this may lead to product decomposition.

IXPER Calcium Peroxide products can also be used in nurseries. They are best applied when transplanting to larger sized containers. If mycorrhizae are incorporated during transplanting, calcium peroxide can further enhance their effect.

**Ornamental plants** – Addition of IXPER Calcium Peroxide to the soil can reduce the problems associated with over-watering of plants such as Azaleas, Carnations, Delphiniums, Edelweiss, and Lupins. Soil measurements after 4 months show the pH change to be insignificant.

**Vegetable plants** – Benefits of IXPER Calcium Peroxide products have also been observed in the cases of vegetable crops such as tomatoes, lettuce, radish and others when the soil was waterlogged. This is suitable in nurseries or for amateur gardeners

#### **Horticulture**

IXPER Calcium Peroxide products are used in horticulture to provide slow release oxygen to crops. Attention should be paid to pH as calcium peroxide is alkaline and might raise the pH of the circulating water. Also, considering IXPER Calcium Peroxide has a very low solubility in water, the drip lines have to be monitored to avoid clogging. Also, concentrated fertilizer should not be mixed with IXPER Calcium Peroxide.

#### **Crops**

The root system of many crops is sensitive to substances produced by soil bacteria growing under anaerobic conditions. Some of these products can be very toxic to root cells or can upset the balance of growth factors.

When plants begin to be affected by the lack of oxygen, some start converting glucose to ethyl alcohol. This can badly upset plant development, especially at flowering time, such as peas and many cereals, causing very severe loss of yield.

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Calcium Peroxide can be added to a field before planting to prevent the soil from becoming anaerobic and thus avoiding the detrimental effects of a poorly aerated soil. It can also be incorporated in the soil soon after the addition of any type of organic matter such as manure or humus in order to enhance their decomposition and speed up the release of substances that affect root activity e.g. polyphenols and quinones.

IXPER Calcium Peroxide may be incorporated at a depth of 6" at a rate of 20kg per acre. This helps reduce the effect of waterlogging especially early in the spring season.

#### **Pond Treatment**

IXPER 70C Calcium Peroxide Granules can be used in oxygenating the lower parts of ponds and flood retention basins. Oxygen concentration near the bottom of these bodies of water can be very low and many methods of increasing dissolved oxygen are unsatisfactory either because they require excessive agitation, which moves nutrients to the surface encouraging algae growth, or because they do not ensure sufficient oxygenation.

By sinking to the bottom and releasing oxygen over a period of time, IXPER 70C Calcium Peroxide Granules can provide a more satisfactory method of oxygenating the lower layers leading to odor control. If microbes are added to the ponds, IXPER 70C Calcium Peroxide Granules would also enhance the growth of these microbes and their beneficial effect.

The use of calcium peroxide in ponds also leads to phosphate immobilization (covered by patents).

#### **Manure Treatment**

The incorporation of a 2.5% slurry of calcium peroxide in manure is suitable for odor control. It can also prevent crusting or settling of livestock slurries.

For additional information about these products, please check other technical datasheets at [www.solvaychemicals.us](http://www.solvaychemicals.us).

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