Introduction
IXPER® 75C Calcium Peroxide is a fine, very pale yellow, odorless amorphous powder that consists primarily of calcium peroxide. The balance consists of calcium hydroxide and other inorganic fillers. IXPER® 75C Calcium Peroxide is Kosher certified and meets the Food Chemicals Codex requirements for use in dough conditioning.

Technical Information
INCI Name  Calcium Peroxide
Formula  CaO₂
CAS Number  1305-79-9
Molecular Weight  72.08
IXPER® 75C Calcium Peroxide
Properties
Product Data Sheet

Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Typical Range</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium Peroxide (%)</td>
<td>78 ± 2</td>
<td>75</td>
</tr>
<tr>
<td>Available Oxygen (%)</td>
<td>17.33 ± 0.44</td>
<td>16.65</td>
</tr>
<tr>
<td>Food Chemicals Codex</td>
<td></td>
<td>Specifications (ppm)</td>
</tr>
<tr>
<td>Fluoride</td>
<td>-</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Lead</td>
<td>-</td>
<td>&lt;4</td>
</tr>
<tr>
<td>Mean Particle Size*</td>
<td>~15µ</td>
<td></td>
</tr>
<tr>
<td>Moisture (%)**</td>
<td>&lt;1.0</td>
<td></td>
</tr>
<tr>
<td>Bulk Density (g/mL)</td>
<td>0.50 ± 0.075</td>
<td></td>
</tr>
<tr>
<td>Solubility in Water @ 20°C (%)</td>
<td>&lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

* Determined by laser method  ** Measured by moisture balance

Effect of Temperature
IXPER® 75C Calcium Peroxide is one of the most temperature stable inorganic peroxides. It decomposes at a temperature >350°C.

- Under dry and cool conditions, IXPER® 75C Calcium Peroxide remains very stable with a relative active oxygen loss of ~1% per year. This is equivalent to an absolute drop in calcium peroxide content of less than 1%.

- Under dry conditions and elevated temperatures, the product is slightly less stable. When stored continuously at 32°C for 6 weeks in polyethylene containers, the relative active oxygen loss is about 2% per year. This is equivalent to an absolute reduction in calcium peroxide content of about 1.5% per year.

Effect of Moisture
IXPER® 75C Calcium Peroxide is only slightly hygroscopic and slightly soluble in water (<0.01% @ 20°C). The pH value of an IXPER® 75C Calcium Peroxide suspension depends upon its concentration.

<table>
<thead>
<tr>
<th>Concentration in slurry (%)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>8</td>
</tr>
<tr>
<td>0.2</td>
<td>11</td>
</tr>
<tr>
<td>1</td>
<td>11.7</td>
</tr>
<tr>
<td>10</td>
<td>12.7</td>
</tr>
<tr>
<td>25</td>
<td>12.8</td>
</tr>
</tbody>
</table>

A study was conducted at Western Michigan University comparing IXPER® 75C Calcium Peroxide with a competitor’s CaO₂ in 1% aqueous suspensions. The competitor product exhibited a lower pH than IXPER® 75C Calcium Peroxide. As discussed later, this difference in pH between the two products affects their rate of oxygen release.
IXPER® 75C Calcium Peroxide slowly decomposes in water with the generation of oxygen and heat. Typically hydrogen peroxide (H₂O₂) is not generated under these conditions due to the high pH of the product.

\[ 2\text{CaO}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{Ca(OH)}_2 + \text{O}_2 (g) \]

A study done at Western Michigan University compared the oxygen release profile of IXPER® 75C Calcium Peroxide and a leading CaO₂ competitor product in 1% aqueous suspensions. The flasks were covered with bubble valves for off-gas release without allowing air to enter.

Results show that IXPER® 75C Calcium Peroxide has a slower release profile than the leading competitor. This trend becomes significantly different after 24 weeks.
The slower oxygen release profile of IXPER® 75C Calcium Peroxide vs. a competitor’s calcium peroxide can be attributed to the difference in pH between the two products, as explained in the following section.

**Effect of Acids**

If calcium peroxide has a pH lower than 12, 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.

\[
\text{CaO}_2 + 2H^+ \rightarrow \text{Ca}^{2+} \text{(aq)} + \text{H}_2\text{O}_2 \\
\text{Ca(OH)}_2 + 2H^+ \rightarrow \text{Ca}^{2+} \text{(aq)} + 2\text{H}_2\text{O}
\]
To illustrate this point, a test was done where sulfuric acid was added to an 0.2% slurry of IXPER® 75C Calcium Peroxide in water. After proper mixing, the slurry was immediately filtered, and the aqueous phase tested for its H$_2$O$_2$ content. Additional acid was then added to the remaining slurry to reach a lower pH, and the process was repeated.

It was observed that H$_2$O$_2$ 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$_2$O$_2$. H$_2$O$_2$ production leveled off at about pH 5.

The H$_2$O$_2$ generated from acidified calcium peroxide slurries can further react in a variety of ways:

\[
\begin{align*}
H_2O_2 + OH^- &\rightarrow H_2O + HOO^- \\
HOO^- + substrate &\rightarrow Oxidized Substrate + HO^- \quad \text{(oxidation)} \\
2H_2O_2 &\rightarrow 2H_2O + O_2 \quad \text{(decomposition)}
\end{align*}
\]

This phenomenon would explain why the leading competitor product with a pH of 10.5 has shown a faster oxygen release profile than IXPER 75C Calcium Peroxide.

**Effect of Metal Impurities**

As with other peroxygens, IXPER® 75C Calcium Peroxide is decomposed by transition metals. The extent of decomposition depends upon the type of impurity, the degree of contamination and contact time. This is important not only during storage, but also in formulations. Ingredients in a formulation containing IXPER® 75C Calcium Peroxide might contain high levels of metal impurities than can lead to the decomposition of the product.
Chemical Reactivity

The reactivity of IXPER® 75C Calcium Peroxide is due to its ability to generate $\text{H}_2\text{O}_2$ and oxygen.

- The $\text{H}_2\text{O}_2$ released can be used for various oxidation reactions.
  - Examples include:
    - Bleaching of stains, as IXPER® 75C Calcium Peroxide can be a component of whitening toothpastes.
    - Bleaching of hair as a component of hair bleaches.
    - Formation of disulfide bonds, as the product can be used as a dough conditioner (see technical datasheets IXP-03-001 and 002 for details), for curing sealants, and to reduce odors in grease traps.
    - Amine and phenol oxidation, such as the oxidation of hair colors.
    - Metal oxidation, such as the oxidation of aluminum in metallurgical processes or immobilization of toxic metals in remediation.
    - Degradation of organic products and polymers as in soil remediation and the use as breaker in oil exploration.

- The oxygen released can be used in a variety of applications.
  - In soil and groundwater assisted natural attenuation, it can maintain the aerobic conditions necessary to enhance biological activity.
  - In agriculture, it provides the oxygen needed for seed germination and root growth.
  - In grease traps, it can keep the system aerobic.
  - In bodies of water, it can replenish dissolved oxygen.

Additional benefits include the regulation of pH in various systems such as pond water and sediments.

Several precautions must be taken in formulating a product containing IXPER® 75C Calcium Peroxide.

- Avoid the use of reducing agents.
- Minimize the incorporation of transition metals.
- IXPER® 75C Calcium Peroxide should be the last component to be added in a formulation after adequate mixing of all other ingredients.
- Since organic compounds can be oxidized by calcium peroxide, proper hazard evaluation must be conducted before mixing IXPER® 75C Calcium Peroxide with any organic compound.
Determination of the Concentration of Calcium Peroxide

Principle
This method is suitable for the determination of the available oxygen and calcium peroxide contents of IXPER® 75C Calcium Peroxide. The sample is dissolved in mixed acid (phosphoric acid and hydrochloric acid), and the available oxygen content is determined by titration with potassium permanganate (KMnO₄) solution.

Reagents
All reagents should be of analytical reagent grade.

- KMnO₄ solution (0.5N)
- Mixed acid: Add 100mL 85% orthophosphoric acid and 100mL 37% hydrochloric acid consecutively with stirring to 600mL demineralized water.

Procedure
- Weigh ~0.5g sample (to ~0.001g) of IXPER® 75C Calcium Peroxide into a 250mL conical flask. Let the mass of sample be Wg.
- Add, by means of a measuring cylinder, 100mL of the mixed acid and swirl until the sample is completely dissolved.
- Immediately titrate with KMnO₄ solution (0.5N) to the appearance of a faint permanent pink color. Let the volume of the KMnO₄ solution (0.5N) used be A mL.

Calculation
Available oxygen (%w/w) = A x N x 0.8/W
Calcium peroxide content (%w/w) = A x N x 3.604/W

Where
- N = normality of the KMnO₄ solution
- A = volume of KMnO₄ used in titration (mL)
- W = weight of sample (g)

Packaging
The product is packaged in 25kg fiberboard boxes. There are 18 boxes to a pallet.
Storage and Handling
- Store in a dry location away from heat and out of direct sunlight in original containers. Storage temperature: <104°F (40°C).
- Store in an area away from acids, bases, metals, metal salts, reducing agents, organic materials or flammable substances.
- Never return unused product to the storage container.
- Rotate inventories - first in, first out.
- Do not stack pallets. Maintain two feet spacing between pallets of drums.
- Equipment used for handling this material should be made of plastic, stoneware, glass or stainless steel. Enameled or resin coated equipment is also suitable. Copper and copper alloys should be avoided.
- Holding equipment must be adequately vented to prevent any pressure build up in the event of product decomposition.

Safety
- Ensure all personnel who may come in contact with this material are aware of the potential hazards, first aid measures and the proper storage and use techniques outlined in the most recent Material Safety Data Sheet (MSDS).
- Storage and use areas should be equipped with a safety shower and eye wash station.
- Use appropriate eye and skin protection.
- Dispose of according to applicable federal, state and local regulations.

Danger: OXIDIZER - CALCIUM PEROXIDE CAN CAUSE SEVERE EYE DAMAGE AND SKIN IRRITATION. IN CASE OF REPEATED CONTACT WITH SKIN, PRODUCT MAY CAUSE DERMATITIS. Prevent contact with eyes and avoid skin contact. Wash hands and skin thoroughly after handling. Damp product in contact with combustible materials may cause fires.

Water is the preferred extinguishing medium in case of fire involving this product.

First Aid
Eye contact: Flush eyes with running water for 15 minutes, while keeping eyelids wide open. Consult with an ophthalmologist in all cases.
Skin contact: Wash the affected skin with water. Remove and clean contaminated clothing. Call a physician in case of persistent pain or redness.
Inhalation: Remove the victim from the dusty environment. Call a physician in case of respiratory symptoms.
Ingestion: Consult with a physician in all cases. DO NOT induce vomiting. If victim is conscious, rinse mouth and give fresh water. Never give anything by mouth to an unconscious person.
Regulatory Information
- DOT Proper Shipping Name: Calcium Peroxide
- DOT Hazard Class: 5.1 (oxidizer)
- UN Code: 1457
- RCRA Waste Number: D001, ignitable
- SARA Section 311/312 hazard category: Fire hazard and immediate health hazard.

Customer Service
The safety of our customers is our highest concern. To discuss safety of use and handling of IXPER® 75C Calcium Peroxide, contact Solvay Chemicals, Inc. at 1-800-SOLVAY-C (765-8292) or 713-525-6500.
24 hour Emergency Phone Number - 1-800-424-9300