**Introduction**

IXPER® 60C 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® 60C Calcium Peroxide is Kosher certified and meets the US Food Chemical Codex requirements for use in dough conditioning. It is mainly used as a source of slow oxygen release in a variety of applications.

**Technical Information**

<table>
<thead>
<tr>
<th>INCI Name</th>
<th>Calcium Peroxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>CaO₂</td>
</tr>
<tr>
<td>CAS Number</td>
<td>1305-79-9</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>72.08</td>
</tr>
</tbody>
</table>
Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Typical Range</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Pale yellow amorphous odorless powder</td>
<td>Pale yellow amorphous odorless powder</td>
</tr>
<tr>
<td>Calcium Peroxide (%)</td>
<td>61.5 ± 1.5</td>
<td>60 min.</td>
</tr>
<tr>
<td>Available Oxygen (%)</td>
<td>13.7 ± 0.4</td>
<td>13.3 min.</td>
</tr>
<tr>
<td>Food Chemical Codex Specifications (ppm)</td>
<td></td>
<td></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>Particle Size Distribution (% pass through)*</td>
<td>75µ (US Sieve #200)</td>
<td>100 min.</td>
</tr>
<tr>
<td></td>
<td>20µ (US Sieve #625)</td>
<td>50 min.</td>
</tr>
<tr>
<td>Moisture (%) – moisture balance</td>
<td>~0.5</td>
<td></td>
</tr>
<tr>
<td>Bulk Density (g/mL)</td>
<td>0.45 ± 0.01</td>
<td>0.45 ± 0.01</td>
</tr>
<tr>
<td>Solubility in Water (20°C)</td>
<td>&lt;0.01%</td>
<td></td>
</tr>
<tr>
<td>pH (1% suspension)</td>
<td>~12.0 ± 0.3</td>
<td></td>
</tr>
</tbody>
</table>

* Determined by Light Scattering (CILAS)

Effect of Temperature
IXPER® 60C Calcium Peroxide is one of the most temperature stable inorganic peroxides. It decomposes at a temperature >355°C.

- Under dry and cool conditions, IXPER® 60C 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 3% per year. This is equivalent to an absolute reduction in calcium peroxide content of about 2% per year.

Effect of Moisture
IXPER® 60C Calcium Peroxide is only slightly hygroscopic and slightly soluble in water (<0.01% @ 20°C). The pH value of an IXPER® 60C Calcium Peroxide suspension depends upon its concentration.

<table>
<thead>
<tr>
<th>Concentration in slurry (%)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.3</td>
</tr>
<tr>
<td>10</td>
<td>12.8</td>
</tr>
<tr>
<td>25</td>
<td>12.8</td>
</tr>
</tbody>
</table>
IXPER® 60C Calcium Peroxide decomposes slowly in contact with atmospheric moisture with the generation of oxygen and heat. Decomposition occurs in a similar way when the product is suspended in water. Typically hydrogen peroxide (H$_2$O$_2$) is not generated under these conditions due to the high pH.

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

The rate of generation of gaseous oxygen is influenced by the physical and chemical properties of the surrounding medium such as pH, temperature and turbulence. In pure water, at room temperature, oxygen generation can continue for close to a year.

**Effect of Acids**

In buffered systems with a pH substantially lower than 12, IXPER® 60C Calcium Peroxide exhibits 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.

$$2\text{CaO}_2 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} \text{ (aq)} + 2\text{H}_2\text{O}_2$$

$$\text{Ca(OH)}_2 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} \text{ (aq)} + 2\text{H}_2\text{O}$$

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

$$\text{H}_2\text{O}_2 + \text{OH}^- \rightarrow \text{H}_2\text{O} + \text{HO}_2^-$$

$$\text{HO}_2^- + \text{substrate} \rightarrow \text{Oxidized Substrate} + \text{HO}^- \text{ (oxidation)}$$

$$2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \text{ (decomposition)}$$

**Effect of Metal Impurities**

As with other peroxygens, IXPER® 60C 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® 60C Calcium Peroxide might contain high levels of metal impurities that can lead to the decomposition of the product.
Chemical Reactivity
The reactivity of IXPER® 60C Calcium Peroxide is due to its ability to generate H₂O₂ and oxygen.

- The H₂O₂ released can be used for various oxidation reactions. Examples include:
  - Bleaching of stains, as IXPER® 60C 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, and for curing sealants.
  - 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 bodies of water, it can replenish dissolved oxygen.

Several precautions must be taken in formulating a product containing IXPER® 60C Calcium Peroxide.

- Avoid the use of reducing agents.
- Minimize the incorporation of transition metals.
- IXPER® 60C 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® 60C Calcium Peroxide with any organic compound.

For additional information about IXPER 60C Calcium Peroxide, check our Applications of IXPER Products technical data sheet.
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® 60C 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 (0.1N)
- Mixed acid: Add 100mL 85% orthophosphoric acid and 100mL 37% hydrochloric acid consecutively with stirring to 600mL demineralized water.

Procedure
- Weigh ~1g sample (to ~0.001g) of IXPER® 60C 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 (0.1N) to the appearance of a faint permanent pink color. Let the volume of the KMnO₄ solution (0.1N) 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)