Analysis of Global Portland Cement Market Size and Share with Properties

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Abstract
Portland cement concrete that is hydraulic cement when combined with water, hardens into a solid mass. Chemical analysis of cement raw materials gave knowledge into the substance properties of cement. In this paper we are discussing about the various chemical composition and properties of Portland cement. In this paper we are also discussing about the market size of Portland cement and application of cement and their ratio.

Keywords: Lime, Silica, fineness, gypsum etc.

I. INTRODUCTION
Portland cement is a simple ingredient of concrete. Portland cement makes a paste with water that binds with sand and rock to harden to form a concrete. These cement has a chemical composition of calcium, silicon, aluminum, iron and other ingredients. Non-hydraulic cements, and hydraulic cement are 2 important classes of development cement. Non-hydraulic cement does not set in wet conditions or under water. Hydraulic cements set and become adhesive due to a chemical reaction between the dry ingredients and water.

Non-hydraulic cements e.g.
(i) Plaster of Paris (CaSO₄·½H₂O)
CaSO₄·½H₂O + ½H₂O → CaSO₄·2H₂O (gypsum)

(ii) lime-based cement (CaO)
CaO + H₂O → Ca(OH)₂ + CO₂→ CaCO₂ (calcite)

II. PORTLAND CEMENT CHEMICAL COMPOUNDS OF PORTLAND CEMENT
It is create by finely ground limestone and finely divided clay to give a burned product containing 65-70% CaO, 18-24% SiO₂, 3-8% Fe₂O₃, 3-8% Al₂O₃ with some others Na₂O, K₂O,
MgO, etc. Present day plants grant considerably more proficient handling and moreover, proportion raw mix compositions to create a cement from which a range of strength development and robustness properties can be expected. Effective crushing and mixing of raw materials is fundamental.

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Fig 1 Portland Cement manufacturing

This table shows the chemical compounds of Portland cement, its formula and properties of this compound with weight.

### TABLE 1
CHEMICAL COMPOUNDS OF PORTLAND CEMENT

<table>
<thead>
<tr>
<th>Compound</th>
<th>Formula</th>
<th>Shorthand form</th>
<th>% by weight</th>
<th>Properties of cement compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alite or tricalcium silicate</td>
<td>Ca$_3$SiO$_5$</td>
<td>C3S</td>
<td>50 - 70%</td>
<td>- It is responsible for early strength&lt;br&gt; - First 7 days strength is due to C3S&lt;br&gt; - It produces more heat of hydration&lt;br&gt; - Cement with more C3S is better for cold weather concreting.</td>
</tr>
<tr>
<td>Belite or dicalcium silicate</td>
<td>Ca$_2$SiO$_4$</td>
<td>C2S</td>
<td>15 - 30%</td>
<td>- C2S hydrates after 7 days. Hence, it gives strength after 7 days.&lt;br&gt; - C2S hydrates and harden slowly and provides much of the ultimate strength&lt;br&gt; - It produces less heat of hydration.&lt;br&gt; - Responsible for long term strength</td>
</tr>
<tr>
<td>Tricalcium aluminate</td>
<td>Ca$_3$Al$_2$O$_6$</td>
<td>C3A</td>
<td>5 - 10%</td>
<td>- The reaction of C3A with water is very fast and may lead to an immediate stiffening of paste, and this process is termed as flash set.&lt;br&gt; - To prevent this flash set, 2 to 3% gypsum is added at the time of grinding the cement clinkers.&lt;br&gt; - C3A liberates a lot of heat during the early stages of hydration, but has little (almost none) strength contribution&lt;br&gt; - Cement low in C3A is sulfate resistant.</td>
</tr>
<tr>
<td>Tetracalcium aluminateferrite</td>
<td>Ca$_4$Al$_2$Fe$_2$O$_9$</td>
<td>C4AF</td>
<td>5-15%</td>
<td>- It hydrates very rapidly.&lt;br&gt; - Contributes very little strength of concrete even though&lt;br&gt; - Also responsible for grey colour of Ordinary Portland Cement&lt;br&gt; - The hydrates of C4AF show a comparatively higher resistance to sulphate attachments than the hydrates of C3A</td>
</tr>
</tbody>
</table>

| Sodium oxide              | Na$_2$O       | N             | 0.5 - 1.3%  |
| Potassium oxide           | K$_2$O        | K             |             |
| Gypsum                    | CaSO$_4$2H$_2$O | CSH$_2$     |             |
The graph 2 shows the market size of Portland cement and other from 2014 to expected 2015. Fig 3 shows the application of cement and their ratio.

III. ANALYSIS OF GLOBAL PORTLAND CEMENT MARKET SIZE AND SHARE

![Graph showing cement market size from 2014 to 2025](image)

Fig 2 Cement market size

![Pie chart showing global cement market share](image)

Fig 3 Global cement market share

IV. CONCLUSION

Portland cement is used worldwide. In this paper we have discussed about the various chemical composition and properties of Portland cement. In this paper we have also discussed about the market size of Portland cement and application of cement and their ratio.

REFERENCES