

TTCP Cement: Getting the Powder Ratio Right

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Abstract. TTCP cement recipes must distinguish molar ratios from weighed mass. This note converts equimolar TTCP/DCPA and TTCP/DCPD mixtures into weighing quantities and identifies checks for the resulting cement. The two dicalcium phosphate forms require different mass ratios and cannot be substituted without evaluation.

Keywords: TTCP; DCPA; DCPD; stoichiometry; cement formulation

1. Balance the calcium and phosphate

Tetracalcium phosphate (TTCP) has formula $\text{Ca}_4(\text{PO}_4)_2\text{O}$. Dicalcium phosphate anhydrous (DCPA) is CaHPO_4 ; the dihydrate (DCPD) is $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$. One mole TTCP plus one mole of either dicalcium phosphate supplies five calcium and three phosphorus atoms: an overall Ca/P ratio of 1.667.

Using approximate formula masses TTCP 366.25, DCPA 136.06 and DCPD 172.09 g/mol gives the equimolar mass splits below. These are stoichiometric calculations for pure starting solids. A 50/50 mass mixture would instead contain a large molar excess of dicalcium phosphate.

For the anhydrous pair, $2 \text{ TTCP} + 2 \text{ DCPA} = \text{HA}$. For the dihydrate pair, $2 \text{ TTCP} + 2 \text{ DCPD} = \text{HA} + 4 \text{ H}_2\text{O}$. These overall balances do not guarantee complete reaction. A published injectable system used equimolar TTCP/DCPD with a phosphate/HPMC liquid [1]; it is a distinct formulation, not a drop-in equivalent to an α -TCP cement.

2. Protect the reaction balance

2.1 Allow for the actual material. Use phase identity, hydration state and assay information to assess the weighed quantities. Loss on drying is not automatically a correction for crystal water: aggressive drying may change DCPD itself. If the lot contains secondary phases, a single moisture correction cannot restore the intended chemistry.

Table 1. Development comparison and interpretation controls.

10 g total solids	TTCP mass	Dicalcium phosphate mass
TTCP + DCPA	7.29 g	2.71 g DCPA
TTCP + DCPD	6.80 g	3.20 g DCPD
50/50 TTCP/DCPA	5.00 g	5.00 g; not equimolar
With inert filler	Recalculate reactive fraction	Preserve ratio within that fraction

Scope. Rounded weighing values are illustrative. Neither stoichiometry nor one published cement system establishes a finished-product specification.

References

1. Burguera EF, Xu HHK, Sun L. Injectable calcium phosphate cement: Effects of powder-to-liquid ratio and needle size. J Biomed Mater Res B Appl Biomater. 2008;84(2):493-502. doi:10.1002/jbm.b.30896.

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