

Mineral Powder Storage: Build a Defensible Retest Basis

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Abstract. A powder can retain its nominal composition while its surface or formulation behavior changes during storage. This guide links package exposure, material characterization and application-relevant testing without assigning an unsupported shelf life.

Keywords: powder storage; humidity; packaging; retest; phase stability

1. Treat the package as part of the study

Identify the material, batch, manufacturing history, fill mass, primary package, closure, headspace and any desiccant. Define unopened storage separately from repeated opening and handling.

Record actual storage temperature and humidity, opening duration, sampling history and transport excursions where relevant. “Stored dry” is not a reproducible exposure record.

Use independent unopened containers for scheduled pulls where possible. Repeatedly sampling one container confounds elapsed storage with cumulative exposure.

2. Separate material families

A study on beta-TCP / monocalcium phosphate cement powder found that temperature, humidity and mixing history affected aging, with changes in phases and cement behavior [1]. These results do not define the stability of pure beta-TCP.

A published alpha-TCP study specifically investigated moisture-dependent powder reactivity [2]. Another study reported surface crystallization after storage of 45S5 glass [3].

The practical inference is to test the actual grade and package. A common calcium-containing chemistry is insufficient to transfer a storage period between powders.

5. A practical storage-study record

Planning matrix, not a specification or validated protocol. Select attributes for the intended use; distinguish expiry, retest and in-use handling.

3. Choose tests by failure pathway

Use moisture or mass-change measurements to flag exposure, but state what the method actually measures. A loss-on-drying result can include other volatiles; thermal mass loss is not automatically water.

Pair phase-sensitive methods with surface-sensitive or functional measurements as needed. Bulk XRD may not fully resolve a small surface change. An unchanged appearance does not establish unchanged reactivity.

For a cement precursor, a controlled setting or hydration response may be more decision-relevant than water content alone. Hold the test formulation and measurement method constant.

4. Establish the baseline first

Retain time-zero data on representative lots in the intended package. Predefine test methods, sampling plan, evaluation intervals and criteria linked to intended use.

Track changes against both baseline variation and method uncertainty. A single passing retest confirms only the attributes measured at that time; it does not validate a longer storage claim.

Accelerated exposure can reveal failure pathways, but extrapolation requires evidence that the same mechanism applies under the intended storage conditions.

Risk / exposure	Evidence to retain	Decision supported
Water / ambient exposure	Package and opening log; fit-for-purpose moisture measurement; method and conditioning details.	Separate packaging failure from material variability.
Phase or surface change	Time-zero and aged phase data; surface/chemical evidence if needed; detection limits.	Identify changes rather than relying on appearance.
Agglomeration / flow change	Matched dispersion procedure, size distribution and relevant handling response.	Distinguish reversible clustering from a changed material.
Formulation drift	Fixed formulation; setting or other justified application response; controls and independent replicates.	Link storage change to the intended process.
Package / lot comparison	Actual package configuration, multiple representative lots, independent container pulls.	Bound conclusions to the tested configuration.
Excursion investigation	Time, temperature/humidity history, seal condition and selected comparative tests.	Support a documented disposition, not automatic release.

6. Report a bounded conclusion

Report lots, package, conditions, interval and attributes. Limit the conclusion to changes detected against predefined criteria over the studied interval. Do not infer an untested shelf life or sterility.

Scope

This guide sets no storage instructions for a Kannrybio grade. Processing, sterilization, drug loading or a finished device may require a separate stability assessment.

References and evidence boundaries

[1] Gbureck U, et al. Factors influencing calcium phosphate cement shelf-life. *Biomaterials*. June 2005;26:3691–3697. doi:10.1016/j.biomaterials.2004.09.036. Original study of a mixed cement powder; not pure beta-TCP.

[2] Effect of moisture on the reactivity of alpha-tricalcium phosphate. *Ceramics International*. 2023. doi:10.1016/j.ceramint.2023.02.193. Public abstract verified; full text not available in this review.

[3] Self-crystallisation, an unexpected property of 45S5 Bioglass. *Chemical Communications*. 2021. doi:10.1039/D1CC04847C. Public indexed excerpt verified; full text not available in this review.

Sources checked 30 October 2026. Research planning guidance only; no Kannrybio lot-performance, clinical or regulatory-approval claim.

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