

Immersion Tests: Close the Mass Balance

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Abstract. Interpret immersion results using specimen mass, solution ions and surface deposits together. This note sets out a mass-balance approach and the records needed to compare exposures. Net mass change alone cannot distinguish dissolution from simultaneous deposition.

Keywords: immersion; dissolution; mass balance; surface deposits; solution chemistry

1. List what can enter and leave

During an immersion test, material can dissolve, particles can detach and new solids can deposit. Retained water or salts can also change the weighed endpoint. Dynamic glass studies emphasize that the measured dissolution response depends on the exposure and sampling arrangement [1].

Original example: start with 100 mg dry specimen. Suppose 8 mg leaves the original solid and 5 mg of new deposit is retained. Final mass is 97 mg, so net loss is only 3%. Reporting 3% as total dissolution would understate the assumed removal in this simple balance.

Use a fixed rinse and dry-to-endpoint procedure and record recovered fragments separately. A wash that removes loosely attached deposits may be useful, but it changes what final mass means. Keep the procedure identical across candidates and time points.

2. Correct for sampling and background

2.1 Calculate the sampled inventory. For constant volume V with removed aliquots v replaced by fresh medium, cumulative net solution inventory of one element at time n is $C_n V + v \sum C_i$ for earlier samples, after blank correction. This assumes well-mixed aliquots and accounts for removed dissolved material, not precipitated material.

Table 1. Development comparison and interpretation controls.

Measurement	What it includes	What it cannot establish alone
Dry mass change	Net removal plus retained additions	Total dissolved amount
Solution concentration	Net dissolved element at sampling	Gross release if precipitation occurs
Surface imaging	Location and morphology of deposits	Chemical identity by appearance
Phase / chemical analysis	Identity of recovered products	Whole-system recovery without mass data

Scope. The examples are arithmetic illustrations. Net dissolved inventory is not gross dissolution when precipitation, adsorption or incomplete recovery occurs.

References

1. Galusková D, Kaňková H, Švančárková A, Galusek D. Early-Stage Dissolution Kinetics of Silicate-Based Bioactive Glass under Dynamic Conditions: Critical Evaluation. *Materials (Basel)*. 2021;14(12):3384. doi:10.3390/ma14123384.

2.2 Work through the units. Illustrative values: $V = 10$ mL, $v = 1$ mL, $C_1 = 2$ and $C_2 = 3$ mg/L. At the second point, net solution inventory is $(3 \times 0.010) + (2 \times 0.001) = 0.032$ mg. Using $C_2 V$ alone gives 0.030 mg and omits the first aliquot.

2.3 Check recovery paths. Collect vessel deposits or detached fragments when they matter to the question. Include blank medium exposed to the same vessel and sampling procedure. If the starting medium contains the element, subtract its contribution consistently, including replacement medium.

3. Development decision

Report net mass change, corrected dissolved inventory and identified solid changes separately. Only calculate a material-removal balance when the relevant transfer and precipitation pathways have been measured or bounded.

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