Influence of the Stirring Mechanism on the Precision of the Fusion for VITRIOX GAS and ELECTRIC

Introduction

Homogenization of the melt is an important aspect of sample preparation for X-ray fluorescence analysis using fusion. Whether the fused bead breaks or remains mechanically stable after cooling, depends largely on the homogenization. Once a stable fused bead has been obtained, it is only possible to judge if the sample is truly homogeneously dissolved in the flux by way of analytical precision (e.g., from ten repeat preparations).

Rotation Stirring vs. Swivel Stirring

The VITRIOX GAS and VITRIOX ELECTRIC fusion machines both use rotation stirring that mixes the sample with centrifugal force together with acceleration and deceleration; in principle, in the same way as one stirs sugar into coffee or tea.

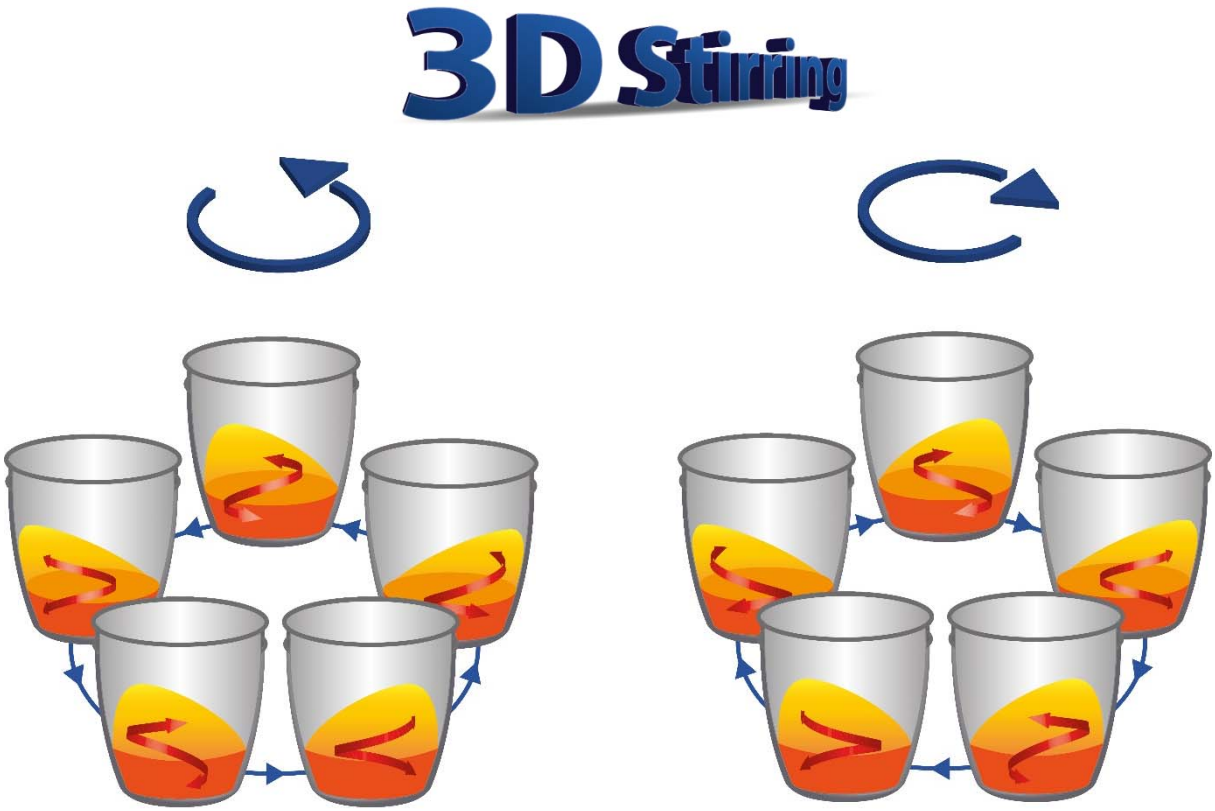

Figure 1: The principle of 3D rotation stirring in the VITRIOX machines.

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All other electrical fusion instruments use the so-called swivel stirring method. In this case, the crucible is swiveled back and forth in a plane. It is quickly clear that this stirring method requires a great deal more time to mix the sample homogeneously. Try this sometime when mixing sugar into coffee or tea.

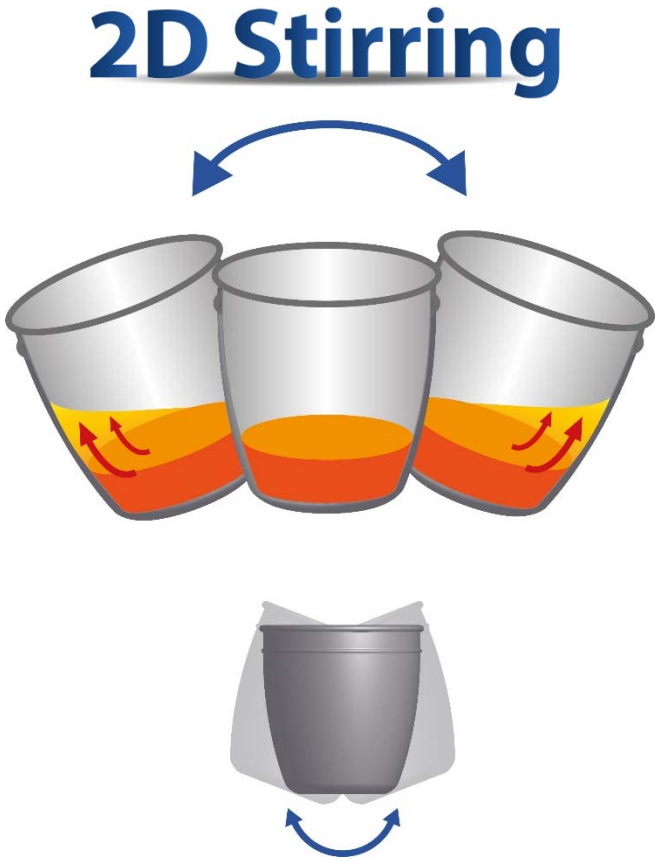

Figure 2: The principle of 2D stirring by swiveling the crucible.

That which appears to be obvious can also be analytically proven by preparing ten repeats of the same sample under the same conditions on each of the fusion instruments and then determining the standard deviation of the concentrations (also called repeatability of the fusion).

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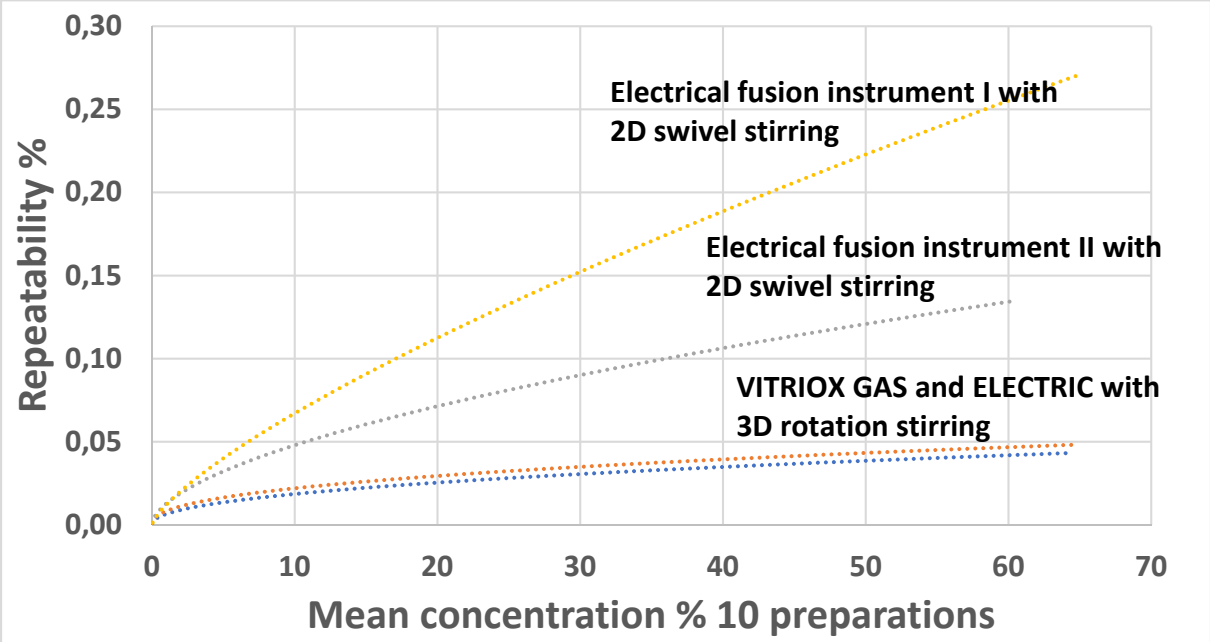

Figure 3: The curves show the dependence of the repeatability on the concentration in the fusion for various fusion instruments. It can be clearly seen that, under the same conditions, rotation stirring leads to better repeatability.

The curves in Figure 3 show the dependence of the repeatability on the concentration in the fusion for four different fusion instruments. VITRIOX GAS and ELECTRIC use rotational stirring and the two competitor products use a swivel stirring method. From the absolute height of the curves, it can be clearly seen that, under the same conditions, rotation stirring leads to the best repeatability – the smallest error.

Dependence of the Homogeneity on the Stirring Speed

The repeatability of a fusion also depends on the sample material. Differing materials display different behavior. The main influence is the viscosity of the fusion; the higher the viscosity, the stronger one must stir. In Figure 4, it can be clearly seen that sand with more silicon must be more strongly stirred than, for example, cement. Only with the 3D stirring of the VITRIOX instruments is it possible to ensure that all materials can be sufficiently homogenized. Simply swiveling, i.e., 2D stirring is often not enough.

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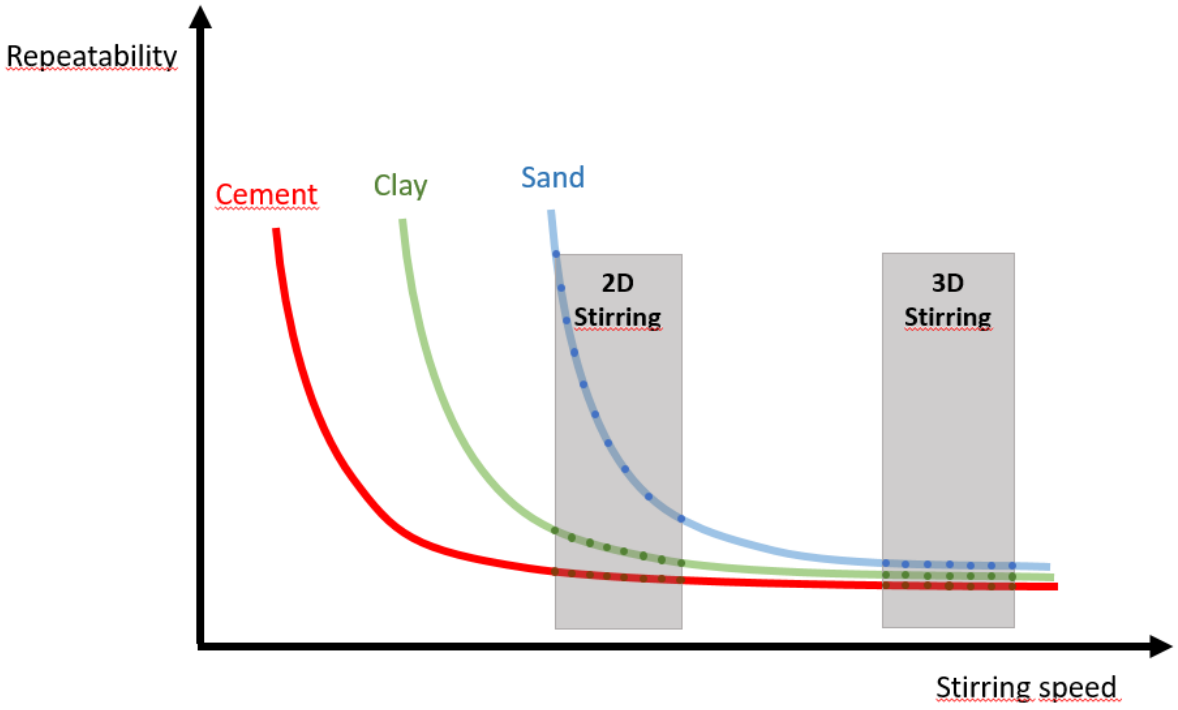

Figure 4: The curves show the dependence of the repeatability on the stirring speed for the fusion of different materials. 3D stirring results in a much better repeatability for different materials.

Literature

[1] Rainer Schramm, Röntgenfluoreszenzanalyse in der Praxis, korrigierte Auflage II, FLUXANA (2017).

[2] www.fluxana.com