Fluorine in toothpaste

- Fast and reliable quality control for toothpaste production

Toothpaste and mouthwash contain many ingredients to enhance the quality and health benefits. Fluorine is added in typical amounts of 1000 to 1500 ppm to prevent cavities by strengthening tooth enamel. Active ingredients are often sodium fluoride (NaF), stannous fluoride (SnF_2), or sodium monofluorophosphate (Na_2PO_3F). In addition to fluoride, other ingredients can be included to achieve whitening effects (peroxide) or abrasiveness (silica).

The fluorine amount has to be accurately controlled. A minimum level of 1000 ppm is needed to provide the desired benefit of strengthening tooth enamel, but exceedingly high fluorine amounts can possibly lead to health risks (dental fluorosis).

With Time Domain Nuclear Magnetic Resonance (TD-NMR), the fluorine content can be accurately measured irrespective of the fluorine compound and the toothpaste matrix.

The simplicity and the speed of the analysis make TD-NMR the method of choice for production, product development and quality control.

Features and Benefits

- Most cost-effective at-line fluorine content determination
- Measurement time < 10 min
- Widely applicable for different toothpaste formulations
- Automation option

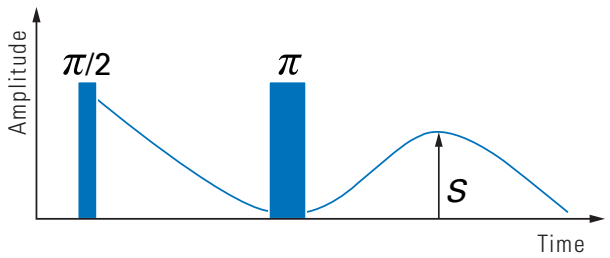
Application Method

The TD-NMR analysis is based on the quantitative and linear signal response from the fluorine nuclei in the sample. Therefore the amplitude of the NMR signal S (Hahn-Echo) is directly proportional to the soluble fluorine mass.

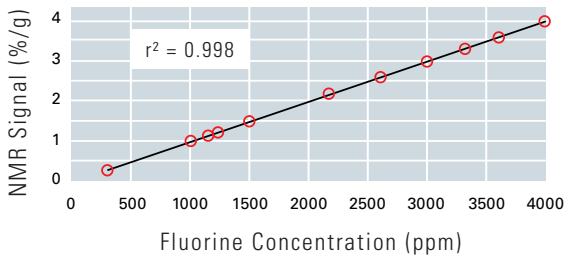
Calibration Procedure

- Calibration range: 250 – 4000 ppm fluorine content
- Linear correlation with $r^2 > 0.995$
- Coefficient of variance (CV) < 3% for repeated measurements of a 1000 ppm sample

Measurement



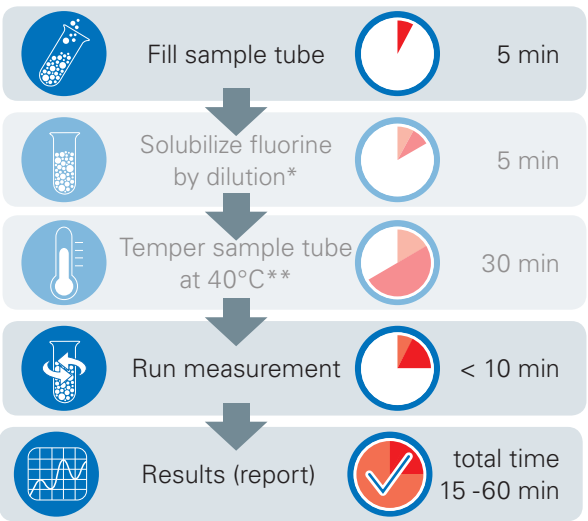
Calibration Curve



Note: Only soluble fluorine is detected due to the very fast signal decay of immobilized or insoluble fluorine, for example in calcium fluoride (CaF_2) or magnesium fluoride (MgF_2). The soluble fluorine contributes to the desired health benefit.

The method is calibrated with 3 to 5 samples of known fluorine content. Aqueous NaF solutions are recommended as calibration samples. Alternatively, solutions of other APIs may be used. The weight-normalized NMR signals (amplitudes) are correlated with the fluorine content by linear regression.

Workflow



*optional, depending on formulation ** optional

Recommended Equipment

- mq20 Toothpaste Analyzer
- m+ software (21 CFR part 11 compliant)
- IQ / OQ Documentation
- 26 mm sample tubes
- Precision Balance
- Option: Automatic sample changer

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