Test Method Number 10

Procedure for Determining the Nonvolatile Residue (NVR) Extractable from Swabs in a Given Solvent

1 Background and Theory

The choice of any material in a cleanroom is critical in terms of the contamination it may contribute to the environment. Swabs are not only present in the cleanroom, but are normally used directly on the products being manufactured or in critical sampling procedures. One form of swab contamination is the soluble matter extractable in a given cleaning solvent (nonvolatile residue or NVR). NVR contamination can remain on a surface after cleaning with a wetted swab.

It is therefore imperative that there be some method of qualification of such materials. Procedures have been drafted in the past to address this issue with textiles and other materials.[1] This procedure addresses the issue as related to swabs and allows for the extraction and determination of the total mass of soluble matter of a swab in a given solvent.

PURPOSE

To determine the amount of gross extractable material (NVR) possible from swabs, under accelerated conditions.

The experiment is performed at or near 50°C to maximize extraction. Even though most applications do not require the selected solvent to be at this relatively high temperature, the experiment is done in this manner to ensure complete extraction over a relatively short period of time. During extraction, a gentle mechanical agitation is applied to assure constant, free flow of the solvent over the swabs suspended in a given solvent. The resultant extract solution is evaporated to dryness, and the total NVR is determined gravimetrically.

Figure 1: Aluminum disc for suspending swabs

EQUIPMENT / MATERIAL

a. Benchtop magnetic stirrer/hot plate, e.g., VWR Scientific's Dyla Dual Model

b. Magnetic stir bars (2" length)

c. Multiple-hole, swab-suspending aluminum disc to accommodate 15–20 swabs, with spring-loaded screws and suspending bar (see Figure 1)

d. Clean 400 mL glass beakers

e. Glass filter funnel and funnel ring holder, clamp, and stand

f. Whatman's grade "4" circular filter paper (12.5 cm dia.) or equivalent

g. Aluminum weighing dishes (typical weight 1.5 g)

h. Analytical balance capable of reading to one-tenth of a milligram

i. Laboratory convection oven

j. Sample swabs to be tested

k. Appropriate solvent for extraction, including deionized water (DIW)

This test procedure does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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Procedure

All use of the solvent(s) should be in a fume hood.

a. Rinse two clean beakers with solvent to be used. Add enough solvent to one beaker to cover the entire swab head as well as an additional 1 cm of handle, ensuring 1 cm of clearance between the swab heads and the bottom of the beaker (see Figure 2). Place the beaker on the hot plate set up in the fume hood.

b. Place a stir bar in the beaker with the solvent and start stirring moderately. Increase and regulate the temperature of the solvent to 50°C ± 5°C.

c. Secure a known number of swabs in the holes of the swab suspending-disc (see Figure 1), which should be held in place over the beaker of solvent with a clamp and stand, suspended with the swab heads pointing downward.

d. Gently lower the disc so that the swab heads and approximately 1 cm of the handle are submerged in the solvent. Let the swabs soak in the constantly stirred solvent for a period of 10 minutes at 50°C ± 5°C (see Figure 2).

e. Elevate the swabs out of the beaker. Pour the solvent with the extracted residue through a cone of a filter paper into the second beaker.

f. Evaporate the filtrate in the second beaker down to ~10–15 mL on the hot plate. *The sample should not be allowed to evaporate to dryness on the hot plate.*

g. Determine the mass of an aluminum weighing dish to five significant figures by alternately weighing and drying in an oven set at 105°C.

h. Transfer the liquid from the beaker (in step f) into the aluminum dish. Place the dish with the liquid on the hot plate and evaporate the liquid further down to ~2 mL.

i. Place the sample dish in the oven (105°C) and evaporate to dryness.

j. Determine the weight of the dish and extracted residue to 5 significant figures.

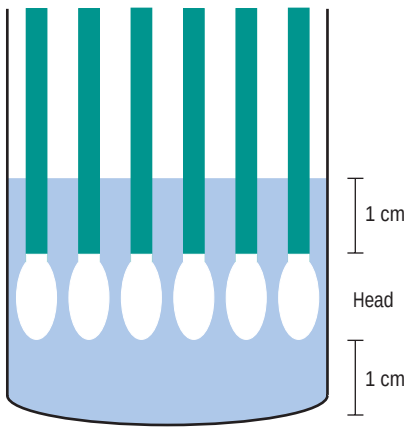

Figure 2: Swab heads suspended in a solvent

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Calculation

Once the number of swabs, the weight of the dish only, and the weight of the dish and the residue are determined, the NVR can easily be determined.

$$\text{NVR (mg/Swab)} = \frac{1{,}000 \times (M_{dr} - M_d)}{n}$$

Where:
M_{dr} = Weight of Dish + Residue (in grams)
M_d = Weight of Dish Only (in grams)
n = Number of swabs used

Note

1. ITW Texwipe Test Method No. 1: "Matter extractable from wipers and other materials."

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