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CONFIDENTIAL

CONSULTANCY TECHNICAL REPORT

Title:	**Material Analysis on 'KS Toothbrush' Sample**
Report No.:	PTS/CTR17/128
Date:	27 April 2017
Job No.:	J20171460198
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Material Analysis on 'KS Toothbrush' Sample

1. Introduction

Five (5) sets of toothbrush sample indicated as 'KS Toothbrush' were received on 17 April 2017. Photograph of one set of 'KS Toothbrush' sample is shown in Figure 1.

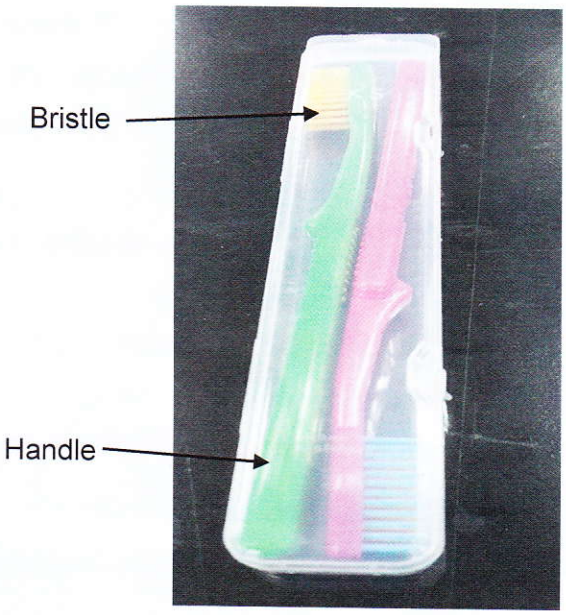

Figure 1. Photograph of one set of 'KS Toothbrush' Sample

The request was to identify the material used for the handle and bristle components of the toothbrush sample.

2. Analysis

The handle and bristle components were analysed using the following techniques:

2.1 Fourier Transform Infra-Red (FTIR) Analysis

The analysis was conducted in accordance to ASTM E1252:2013 - Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis. Small specimen cut from each of the handle and bristle components of the 'KS Toothbrush' sample was placed directly onto a Golden Gate Diamond Attenuated Total Reflectance (ATR) accessory and scanned in reflectance mode for 16 times from 4000 cm^{-1} to 600 cm^{-1} using FTIR spectrometer (Brand: Nicolet, Model: iS50, S/N: AUP1300565) to obtain their infrared spectra.

2.2 Differential Scanning Calorimetry (DSC) Analysis

The analysis was conducted in accordance to ASTM D3418:2012 - Standard Test Method for Transition Temperatures, Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry. Approximately 7 mg and 6 mg of the handle and bristle components of the 'KS Toothbrush' sample respectively were heated at 10°C/minute, using a DSC Analyser (Brand: Mettler Toledo, Model: DSC 882^e, S/N: 5118254453) from 25°C to 300°C. Throughout the experiment, nitrogen was used as the purge gas and the flow rate was maintained at 50 ml/minute.

3. Results and Discussion

3.1 Handle Component of the 'KS Toothbrush' Sample

FTIR spectrum of the handle component of the 'KS Toothbrush' sample is shown in Figure 2.

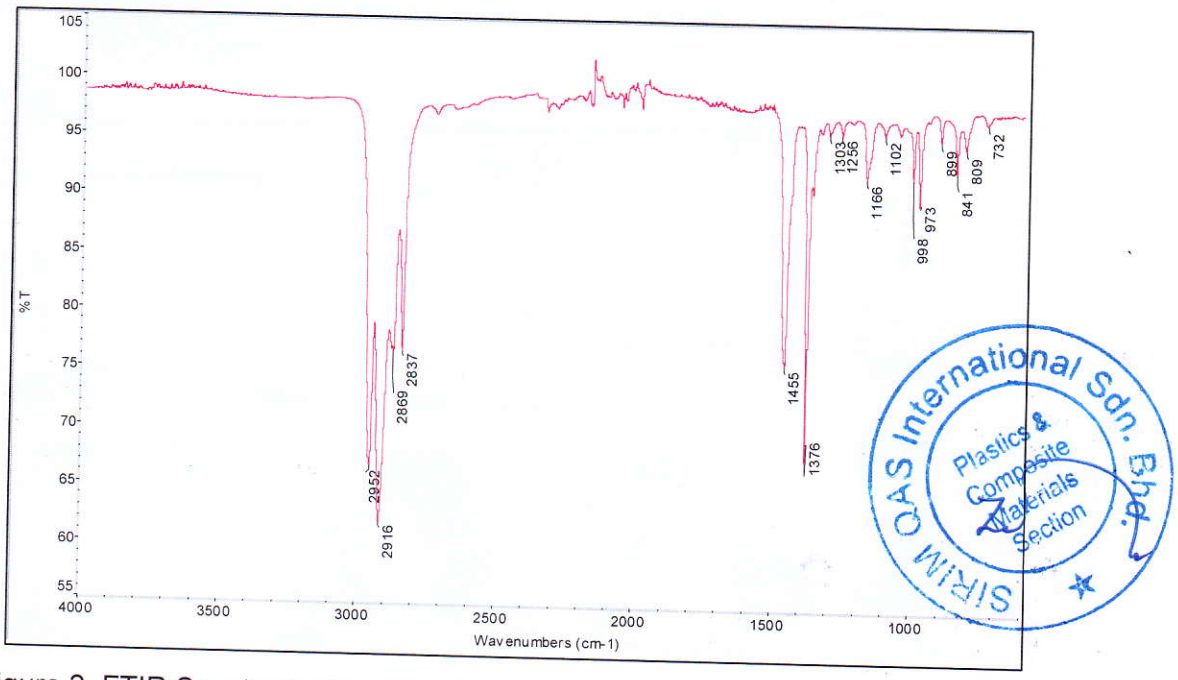

Figure 2. FTIR Spectrum of the Handle Component of the 'KS Toothbrush' Sample

The most matching spectrum for the handle component when compared against the available commercial material library database, was found to be that of reference polypropylene (PP) material. Overlaid FTIR spectrum of the handle component with reference PP is given in Figure 3.

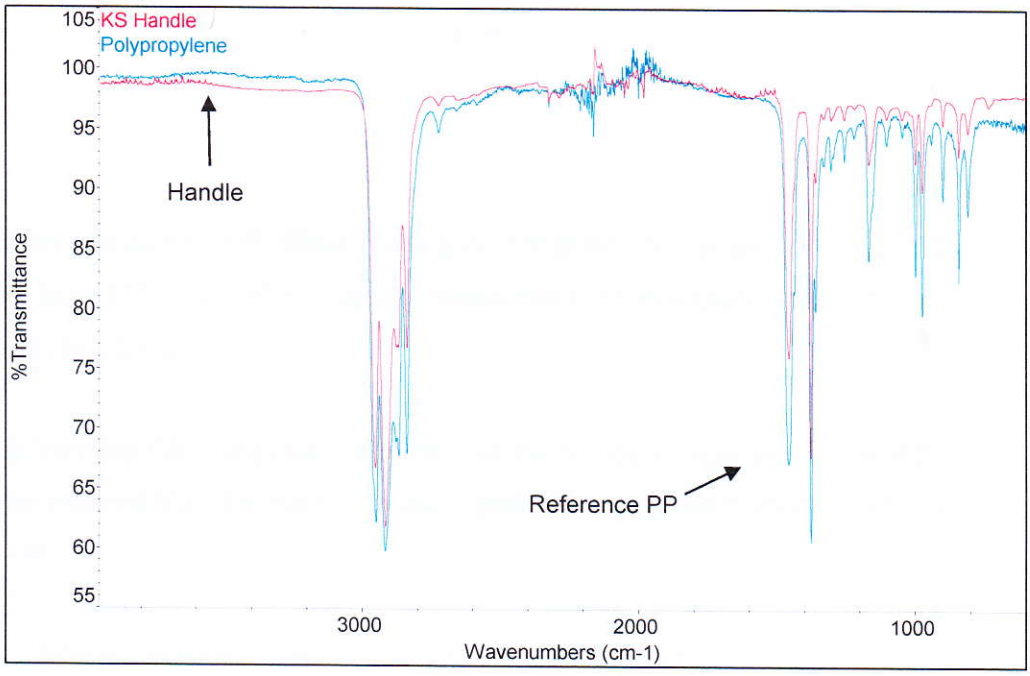

Figure 3. Overlaid FTIR Spectra of the Handle Component of the 'KS Toothbrush' with Reference PP

The DSC curve for the handle component of the 'KS Toothbrush' sample is shown in Figure 4.

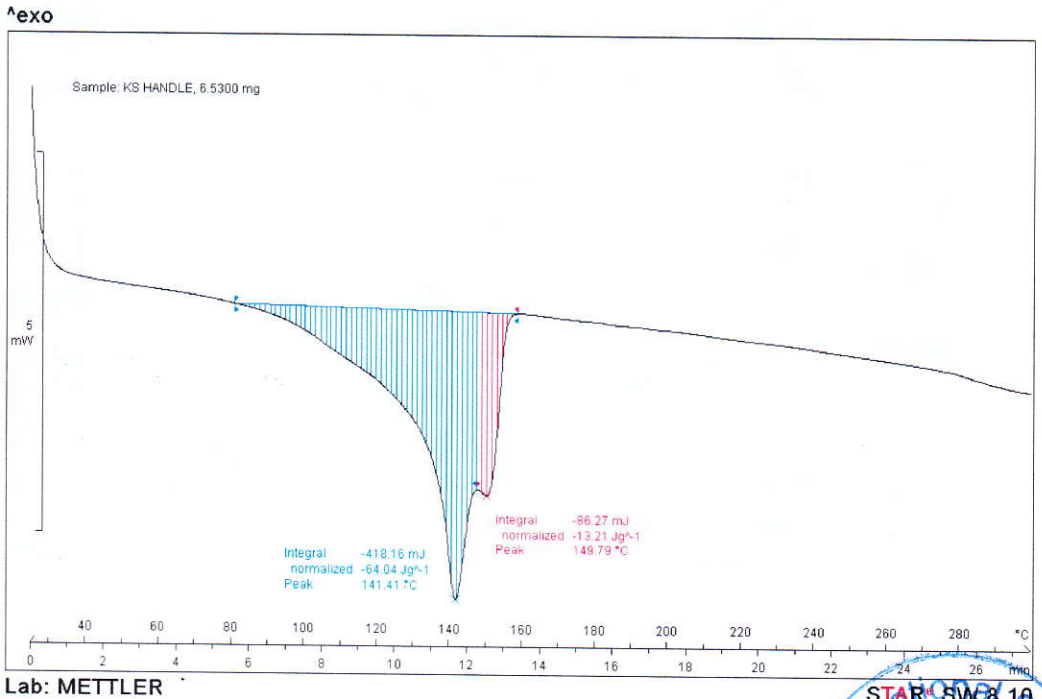

Figure 4. DSC Curve of the Handle Component of the 'KS Toothbrush' Sample

It can be seen from Figure 4 that the handle component has two crystalline endothermic melting peaks at approximately 141°C and 150°C.

Commercially there are three types of PP materials viz. homopolymer, random copolymer and block copolymer PP. While melting points of homopolymer and block copolymer PP ranges from 160°C to 165°C, random copolymer PP has a lower melting point in the range of 135°C to 150°C.

Result from the DSC analysis conducted on the handle component of the 'KS Toothbrush' sample inferred that the handle is most probably made up from random copolymer PP material.

3.2 Bristle Component of the 'KS Toothbrush' Sample

FTIR spectrum of the bristle component of the 'KS Toothbrush' sample is shown in Figure 5.

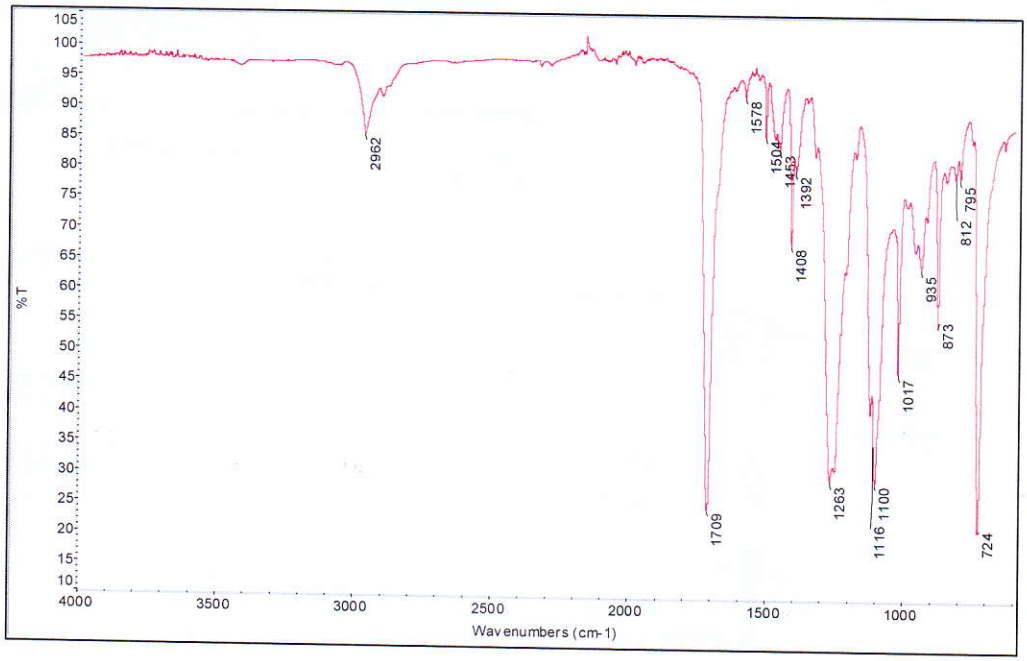

Figure 5. FTIR Spectrum of the Bristle Component of the 'KS Toothbrush' Sample

The most matching spectrum for the bristle component when compared against the available commercial material library database, was found to be that of reference polybutylene terephthalate (PBT) material. Overlaid FTIR spectrum of the handle component with reference PBT is given in Figure 6.

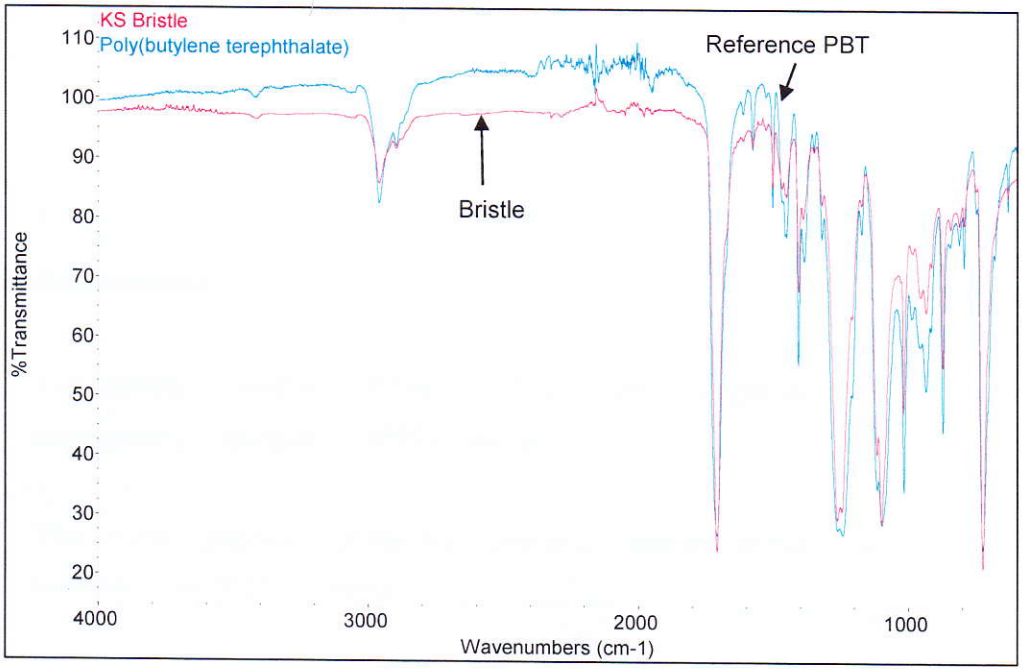

Figure 6. Overlaid FTIR Spectra of the Bristle Component of the 'KS Toothbrush' Sample with Reference PBT

The DSC curve for the bristle component of the 'KS Toothbrush' sample is shown in Figure 7.

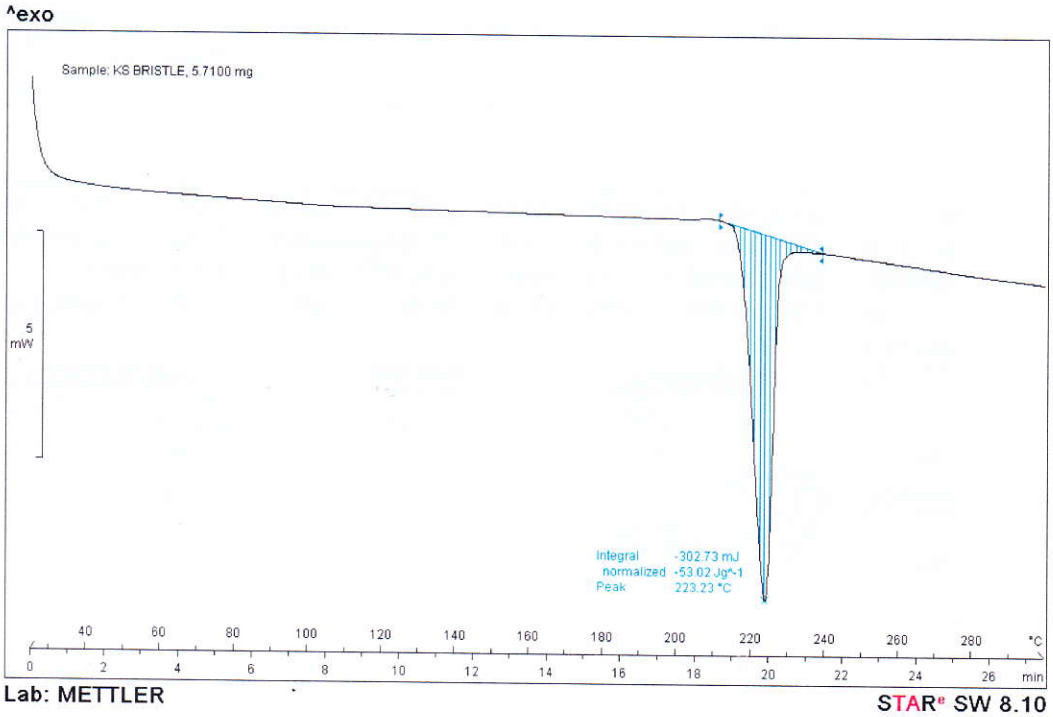

Figure 7. DSC Curve of the Bristle Component of the 'KS Toothbrush' Sample

It can be seen from Figure 7, that the bristle component of the 'KS Toothbrush' sample has a very prominent single crystalline melting peak at approximately 223°C. This is a characteristics to that of PBT material that has a melting temperature range from 220°C to 270°C.

4. Conclusions

i. The handle component of the 'KS Toothbrush' sample is made up of random copolymer polypropylene (PP) material.

ii. The bristle component of the 'KS Toothbrush' sample is made up of polybutylene terephthalate (PBT) material.