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Title: A comparison of the Characteristics of ISO Fine Test Dust versus Real House Dust.

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1 Introduction

Domestic products, such as vacuum cleaners are often tested using inert particle mixtures called 'test dust'. Depending on the standard's testing requirements, the test dust consists of a defined mixture of silicon dioxide, aluminum, iron and sodium oxides and other components such as talcum powder, wood flour and potassium chloride (ASTM. 2007, CEI IEC. 2004, ASTM. 2004). The test dusts are graded according to their particle size range. ISO 12103-1 A2 Fine Test Dust (or ISO Fine Dust) is a test dust with a particle size range from 1-80µm. ISO Fine Dust is used in ASTM standard F2608-07 (ASTM. 2007) for determining the change in room air particulate counts as a result of test dust removal from floor coverings with the vacuum cleaner under test.

Household dust is composed of a heterogeneous mixture of fibers and irregularly shaped particles of varying particle sizes and composition. Particle sources include skin, hair, mites, plant pollen, fibers, soil, road dust, cooking emissions, heating emissions and cigarette smoke (Edwards et al. 1998; Molhave et al. 2000).

Comparison of the particle size distribution of the ISO Fine Dust with that of household dust by laser diffraction, demonstrated that ISO Fine Dust bears little resemblance to the 'real' dust that a vacuum cleaner would encounter in the home (nor does it purport to).

The aim of this study was to determine if a test dust, more representative of household dust, should be produced and standardized for domestic appliance testing.

2 Materials/Methods

Household dust was collected from vacuum bags, pooled from several homes, as composite samples, called VB1 and VB2. In addition, household dust was taken from individual vacuum bags from 10 individual homes, called VB3-VB12. Household dust samples were stored at ambient temperature until sieving. The bulk dust from each VB sample was mixed and hand-sieved with a 2mm sieve to remove fibers and large debris. 2g aliquots of sieved dust samples (VB1-12) and ISO Fine Dust (Powder Technology Inc (PTI). MN, USA) were transferred into separate labelled tubes. Particle size determination was performed at the Pharmacy Dept., Trinity College Dublin, Ireland using a Malvern Mastersizer 2000 (Range of Detection 0.02-2000µm). The average results for VB1-12 household dust are reported as Particle Volume Distribution, % Volume Less Than and Particle Count Distribution and compared to ISO Fine Dust results.

3 Results

Table 1: Particle Distributions by Volume for ISO Fine Dust and Household Dust (Average VB1-12).

Particle Size (micron)	ISO Fine Dust Volume (%)	ISO Fine Dust Volume Less Than (%)	Household Dust Volume (%, n=12)	Household Dust Volume Less Than (%, n=12)
0.2	1.26	0.12	0.00	0.00
0.4	4.00	1.38	0.00	0.00
0.8	2.07	5.38	0.05	0.00
1.0	9.93	7.45	0.74	0.05
2.0	19.61	17.38	1.75	0.79
4.5	16.33	36.99	2.72	2.54
8.9	10.95	53.32	5.14	5.25
15.9	4.43	64.27	3.41	10.39
20.0	15.86	68.7	14.42	13.79
39.9	14.81	84.56	18.07	28.21
89.3	0.63	99.37	11.74	46.28
158.9	0.00	100	5.11	58.02
200.0	0.00	100	16.25	63.13
399.1	0.00	100	12.93	79.38
796.2	0.00	100	6.27	92.31
1415.9	0.00	100	0.00	98.59

The particle distributions (% Volume and % Counts) for household dust were markedly similar for all samples VB1-12 (data not shown). The average particle distributions for VB1-12 were compared to that of ISO Fine

Dust, as shown in Table 1. The % by volume of particles in ISO Fine Dust ranged from 0.2-90µm and in household dust ranged from 0.8-796µm. In Table 1, ISO Fine Dust, particle volumes peaked at 2µm, 4.5µm and 20µm. In contrast, particle volumes in household dust peaked at 20µm, 40µm and 200µm.

In relation to % volume under size, 99% of the particles were <90µm with 53% <9µm and 18% of these <2µm in ISO Fine Dust. This is in agreement to that reported by the manufacturer (PTI). In contrast, in household dust, 46% of particles were <90µm and only 0.79% were <2µm. % Counts, were also obtained for household dust in comparison with ISO Fine dust. The % Count distributions are shown in Figure 1.

Figure 1: % Count Distributions for ISO Fine Dust and Household Dust (n=12) for particle size range from 0.3-60µm.

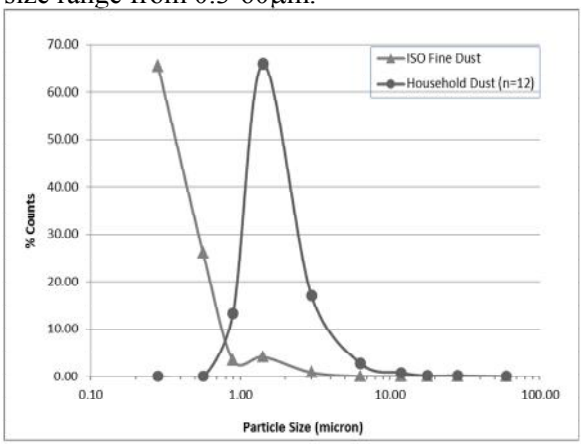

Figure 1 shows that of the particles counted in household dust. 99.65% were <10.0µm with 65% at 1.5µm, whereas in ISO Fine Dust, most were <1.0µm, with 65% at 0.3µm.

4 Conclusions

Standardisation of consumer product testing is necessary to assist in making informed decisions and test dusts will always have a place in vacuum cleaner testing. However, from this study we found that the particle size distribution of ISO Fine dust, which is used for F2608-07 (ASTM, 2007), is markedly different to the dust a vacuum cleaner would encounter in the home. Therefore, a test dust, more closely resembling 'real' household dust should be used in conjunction with the current test dusts, for vacuum cleaner testing. Although house dust is heterogeneous, the particle distributions were remarkably similar for all dust samples tested in this study. Based results of this study, production of 'real' test dust should be relatively straightforward and inexpensive, using pooled sieved dust from vacuum bags. Standardisation would involve particle size distribution analysis. There is little information in the literature on particle sizing of household dust. In this study, the particle volume distribution for household dust, is similar to that reported by Lewis et al. (1999), using % by weight. Hunt et al. (2008) reported that the coarser particles of house dust were preferentially removed from vinyl flooring during vacuum cleaning and 73% of finer particles (<10µm) remained on the floor due to particle-surface adhesion forces. Thus vacuum bag dust may contain less fine particles than normally found in household dust**.** However, these adhesion forces may also occur with the test dusts currently used in vacuum cleaner testing. Use of 'real' test dust in conjunction with current test dusts, should provide additional important information for testing purposes, but its composition may require some modification.

5 References

ASTM. 2004. *F1977-04*, Standard Test Method for Determining Initial, Fractional, Filtration Efficiency of a Vacuum Cleaner System. PA: American Society of Testing Materials International.

ASTM. 2007. *F2608-07*, Standard Test Method for Determining the Change in Room Air Particulate Counts as a Result of the Vacuum Cleaning Process. PA: American Society of Testing Materials International.

CEI IEC. 2004. CEI/*IEC 60312*, Vacuum Cleaners for household use – Methods of measuring performance. Geneva: International Electrochemical Commission.

Edwards R, Yurkow E and Lioy P. 1998. Seasonal Deposition of house dusts onto household surfaces. The Science of the Total Environment 224, 69-80.

Hunt A, Johnson DL, Brooks J and Griffith DA. 2008. Risk remaining from fine particle contaminants after vacuum cleaning of hard floor surfaces. Environ Geochem Health 30, 597-611.

Lewis R, Fortune C, Willis R, Camann D and Antley J. 1999. Distribution of Pesticides and Polycyclic Aromatic Hydrocarbons in House Dust as a function of Particle Size. Environmental Health Perspectives 107(9), 721-726.