



POWDER TESTING GUIDE:

Methods of Measuring
the
Physical Properties
of
Bulk Powders

L. SVAROVSKY

Published on behalf of the
BRITISH MATERIALS HANDLING BOARD

by

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Standard methods of measurement of physical properties of powders in relation to bulk handling and processing have been adopted for specific materials and have sometimes been incorporated into a BS or other Standard. However, general standardised methods have yet to be established and the British Materials Handling Board believes that much wider applications could be made of proven techniques which, while being well established in specific industries, have yet to be generally exploited.

This Guide reviews, details and recommends preferred test methods, outlines their significance and identifies test methods on powder characteristics which require further research, development or evaluation. The accent is on simple and inexpensive techniques. The Guide draws on existing Standards, Trade and Research literature and on expert knowledge of selected designers and manufacturers of powder handling plants; it will prove valuable in disseminating knowledge on simple powder testing techniques and assist in establishing better communication between equipment users and suppliers. The book will be of interest to Materials Scientists, Chemical Engineers, Powder Technologists and the pharmaceutical industry.

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Contents

<i>Foreword</i>	v
<i>Author's Acknowledgements</i>	vii
<i>Scope</i>	ix
Introduction	1
1 Sampling	3
2 Properties Dependent on Single Particle Characteristics	11
2.1 Selection of Relevant Characteristic Particle Size	12
2.2 Description of Particle Size Distribution and Mean Size	13
2.3 Particle Shape	14
2.4 Particle Density	16
2.4.1 Measurement of Particle Density	17
2.4.1.1 Liquid Pyknometry	17
2.4.1.2 Air Pyknometry	17
2.4.2 Measurement of Effective (Aerodynamic) Particle Density	20
2.4.2.1 Caking End Point Method	20
2.4.2.2 Bed Voidage Method	21
2.4.2.3 Bed Pressure Drop Method	22
2.4.2.4 Sand Displacement Method	23
2.5 Surface Area of Powders	23
2.6 Moisture Content	29
3 Categorisation of Powders According to Behaviour in Handling	35
3.1 Classification of Powders in the De-Aerated State	35

3.1.1	Classification on the Basis of Shear Cell Testing	36
3.1.2	Classification on the Basis of Tackiness	37
3.2	Classification of Powders in the Aerated State	38
3.3	Classification of Powder Handling Properties in Pneumatic Conveying	40
4	Non-aerated Flow and Handling Properties	41
4.1	Definition of Failure Properties	41
4.2	Angle of Wall Friction	47
4.3	Angle of Internal Friction	48
4.3.1	Shear Cells	49
4.3.2	Biaxial and Triaxial Shear Testers	52
4.3.3	Direct Method (Grooved Plate)	53
4.4	Failure Function	54
4.4.1	Indirect Methods	55
4.4.2	Direct Methods	55
4.4.2.1	Uniaxial Compression—William's Method	55
4.4.2.2	Compression Tackiness Tester	58
4.4.2.3	Large-Scale Uniaxial Test	61
4.5	Tensile Strength	62
4.5.1	Split Cell Testers	63
4.5.2	Lifting-Lid Testers	66
4.6	Cohesion	67
4.7	Angle of Repose and Other Handling Angles	71
4.7.1	Angle of Repose of a Heap	73
4.7.2	Drained Angle of Repose	74
4.7.3	Angle of Slide	75
4.7.4	Conveying Angle	75
4.7.5	Angle of Sliding	76
4.7.6	Angle of Spatula	76
4.8	Flowability and Flowrate Tests	77
5	Packing Properties, Bulk Densities	79
5.1	Porosity of a Packed Bed, Void Ratio	79
5.1.1	Measurement of Porosity	81
5.2	Bulk Density of a Powder	81
5.2.1	Aerated Bulk Density	83
5.2.2	Poured Bulk Density	84
5.2.3	Tap Density	89
5.2.4	Hausner Ratio	92

CONTENTS

xiii

5.2.5	Compressibility (from Bulk Densities)	93
5.2.6	Compacted Bulk Density	93
5.3	Compaction Tests	93
6	Grinding and Strength Properties	97
6.1	Single Particle Strength	98
6.2	Hardness	98
6.3	Grindability Tests	99
6.4	Impact Tests	103
6.5	Compression Tests	104
6.6	Vibration Tests	104
6.7	Abrasion Tests	104
6.8	Friability/Attrition Tests	106
7	Aerated Flow and Handling Properties	111
7.1	Fluidization Tests	111
7.1.1	Equipment for Fluidization Tests When Using Fine Powders	112
7.1.1.1	Column Size	112
7.1.1.2	Distributors	112
7.1.1.3	Leak Testing	113
7.1.1.4	Pressure Drop Measurement	114
7.1.1.5	Air Supply	114
7.1.2	Measurement of Minimum Fluidization Velocity	115
7.1.3	Minimum Bubbling Velocity	116
7.1.4	Bed Expansion	117
7.1.5	Bed Collapse, De-Aeration Rate	118
7.2	Simple De-Aeration Tests	120
7.3	Permeability	121
7.4	Dustiness	122
7.5	Floodability	126
7.6	Apparent Viscosity Tests	127
8	Conclusions, Future Work	131
9	References	133
	<i>Index</i>	139

INTRODUCTION

In the process of compiling this Guide, it became clear that powder testing can be put into three categories as follows:-

Category A where standardised tests already exist and the interpretation of data is well established and accepted; the only work needed is in publicising their existence and use.

Category B where test methods exist but there is disagreement as to the significance of the measured values in equipment design and scale-up; validation testwork is clearly needed here.

Category C where no standardised test procedures are yet available for a particular powder property and these need to be developed experimentally.

The Guide is not written in the order of the above categories but they are assigned at the end of the discussion of each test method. The bulk powder tests are reviewed in the order of the following groups of powder properties to which they relate:

- Properties dependent on single particle characteristics
- Properties of non-aerated powders
- Packing properties, bulk densities
- Grinding and strength properties
- Properties of aerated powders

Prior to embarking on the review, as a general observation, it is interesting to note that there is an imbalance in the area of powder testing in favour of very detailed particle size and shape

measurements using very sophisticated and expensive laboratory instrumentation, without yet having the fundamental correlations to translate the measured data into secondary behaviour. With the notable exceptions of research organizations or large companies with specialised goals and applications, such intense pre-occupation with very detailed physical data is often made at the expense of testing for other important powder properties. The number and quality of the books available on particle size measurement, in contrast to those on other powder testing methods, is a good indication of this imbalance; it is hoped that this Guide will help to redress the balance.

Another point to be made here concerns the effects of gas properties. Generally, the effect of the interstitial and surrounding gas on the mechanics of dry solids handling is neglected. The effects of gas properties may be two-fold:

1. An aerodynamic interaction between the gas and the solids, mainly controlled by the dynamic viscosity of the gas and the elasticity of the packed solids.
2. A physical-chemical interaction through adsorption of the gas on the solid surface, which affects the resistance to breakage, attrition and abrasion. Thus the properties of the suspending gas have to be taken into account, or controlled, not just in the obvious applications where gas clearly plays a part like fluidization or pneumatic conveying but also in the not-so-obvious ones like grinding and discharge of powders from hoppers.

Moisture content in the gas is known to affect most solids handling properties to the extent that, if powders cannot be kept reasonably well sealed, air-conditioning is necessary if meaningful data are required from powder tests.

Scope

The Guide confines itself to dry solids (as opposed to wet cakes) but includes the effects of air humidity. It deals mostly with powders, typically finer than about 3mm, and it excludes detailed description of electrical and thermal properties and explosion/fire hazard testing. The reader is referred to Ref. 82 for these.

The emphasis is on bulk or "technological" properties of powders and the primary properties like particle size, shape and distribution are treated only as background. The problems and importance of sampling are included but merely for guidance rather than in technical detail.