Assessing support packs from an occupational hygiene perspective

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CONTENTS

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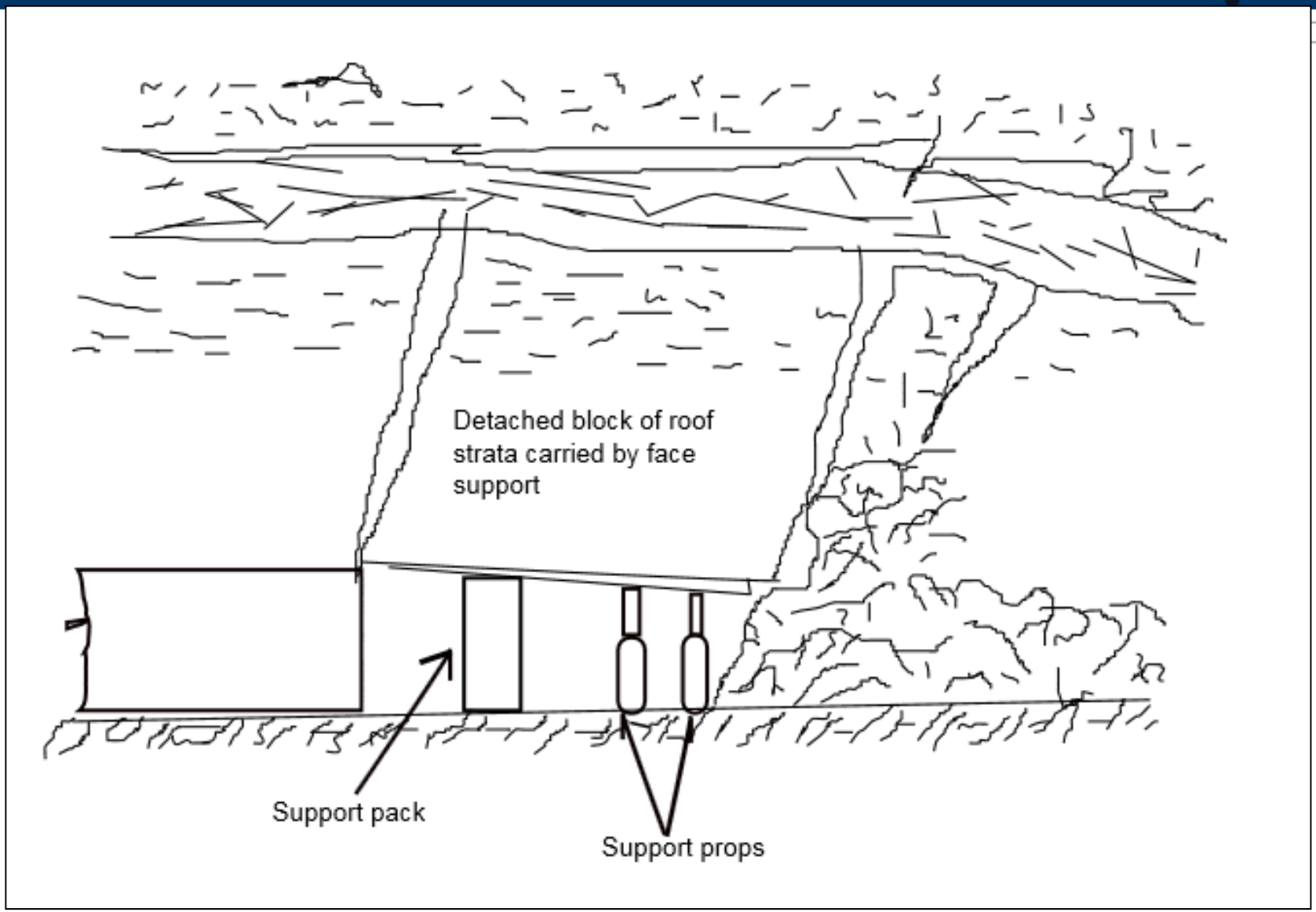
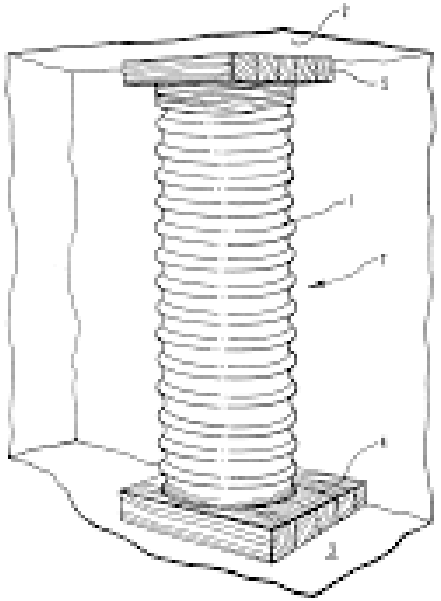
INTRODUCTION

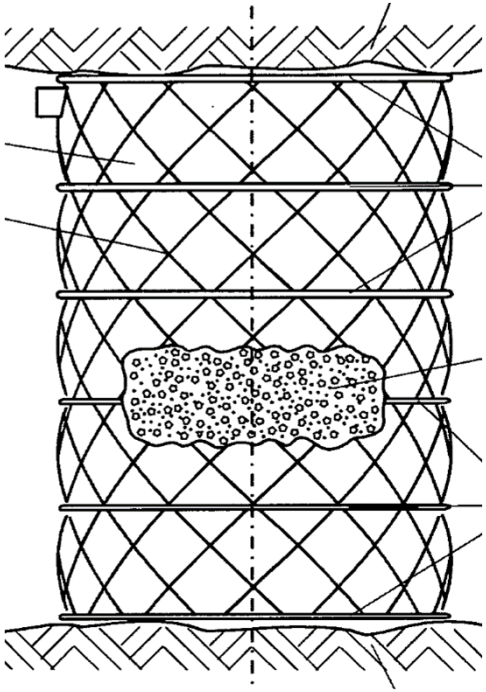
- Pumped cementitious grout packs used for support
- Main function: safety
- Paper explores support packs from an occupational hygiene perspective

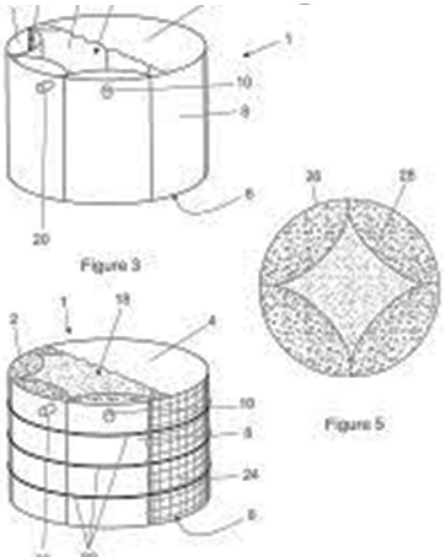
BACKGROUND

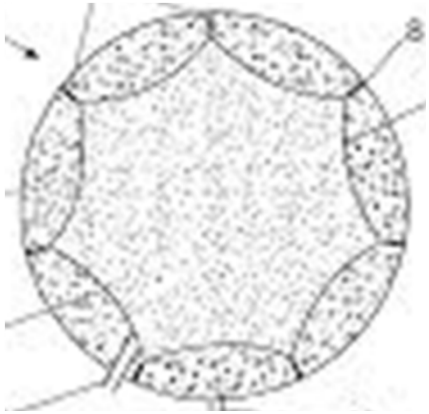

Detached block of roof strata carried by face support
Support pack
Support props

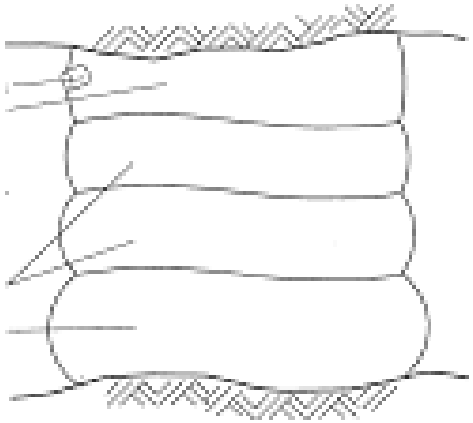
BACKGROUND











BACKGROUND

- **Cement-based compound mixed with water**

https://www.researchgate.net/figure/275339169_fig4_Fig-4-Non-woven-geotextile-bag-fixed-in-filtration-unit

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BACKGROUND

Company	Curing time (days)	Average force (kN)	Displacement (mm)
A	7	2418	400
B	7	3162	400
A	21	2434	400
B	21	3587	400
SPM3	14	7091	400
SPM4	14	6183	400

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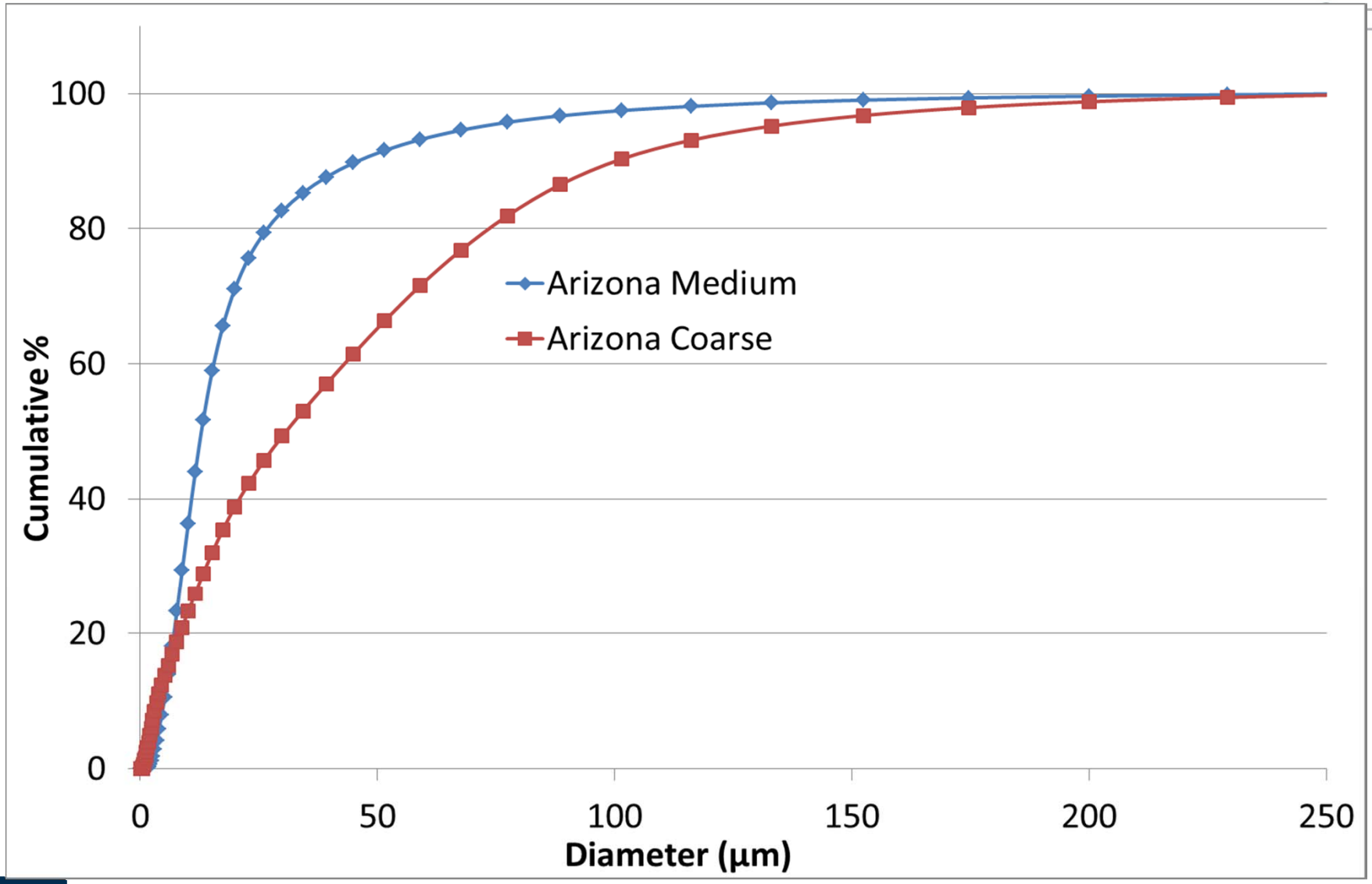
BACKGROUND

BACKGROUND


100
80
60
40
20
0
Cumulative %
0
50
100
150
200
250
Diameter (µm)
Arizona Medium
Arizona Coarse

BACKGROUND

- Producers of minerals must comply with the UN's Global Harmonised System (GHS)
- EU Regulation Classification, Labelling and Packaging (CLP)
- Assess health effects of fine fraction crystalline silica

BACKGROUND

- Mineral mixture ≥ 1wt% crystalline silica: classify
- STOT RE Category 1: ≥ 10 wt% *fine fraction CS*
- STOT RE Category 2: 1 - 10 wt% *fine fraction CS*
- Fine fraction CS is only a problem once airborne
- How to relate “fine fraction CS” in bulk to respirable crystalline silica?

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BACKGROUND

- **Industrial Minerals Association – EU developed:**
  - **SWeRF: size-weighted potential respirable fraction**
  - **SWeRF*cs*: size-weighted potential respirable fraction crystalline silica**
- **Quantify fine fraction in bulk**

BACKGROUND

- Relationship between PSD and probability of dust reaching alveoli (EN 481)
- SWeRF: *potential* for respirable fraction in bulk => classification, labelling and packaging.
- One risk assessment method
- Not to replace conventional personal exposure measurements

OBJECTIVE

- **Assess the probable risk of personal exposure to crystalline silica in support pack material (SPM)**
- **Apply the SWeRF methods on SPM**

METHODOLOGY

- SPM1 – Mine 1;
- SPM2 – Mine 2;
- SPM3 – Supplier 1; and
- SPM4 – Supplier 2.
- Qualitative X-Ray Diffraction (XRD) analysis (bulk and fine)
- Particle Size Distribution (PSD) analysis (bulk and fine)

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METHODOLOGY

- **SWeRF calculation method (SWeRF*calc*):**

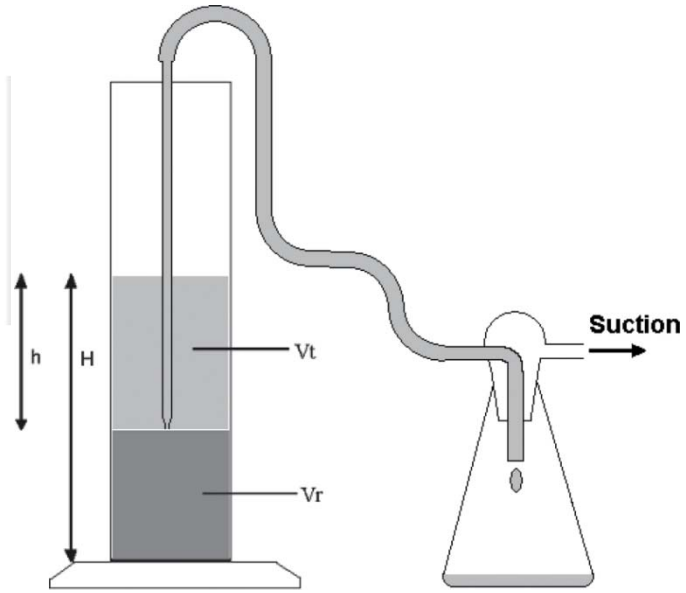
$$\mathrm{SWeRF} = \int_{D=0}^{D=\infty} P(D) \times R(D)\,\mathrm{d}D$$

- **PSD and specific gravity of material used in formula**
- **Calculated fine fraction in the bulk**

METHODOLOGY

- **SWeRF sedimentation method (SWeRF*sed*):**

$$\mathrm{SWeRF}(\%) = \frac{H}{h} \times \frac{m}{M} \times 100$$



https://www.researchgate.net/publication/259586963_SWeRF-A_Method_for_Estimating_the_Relevant_Fine_Particle_Fraction_in_Bulk_Materials_for_Classification_and_Labelling_Purposes

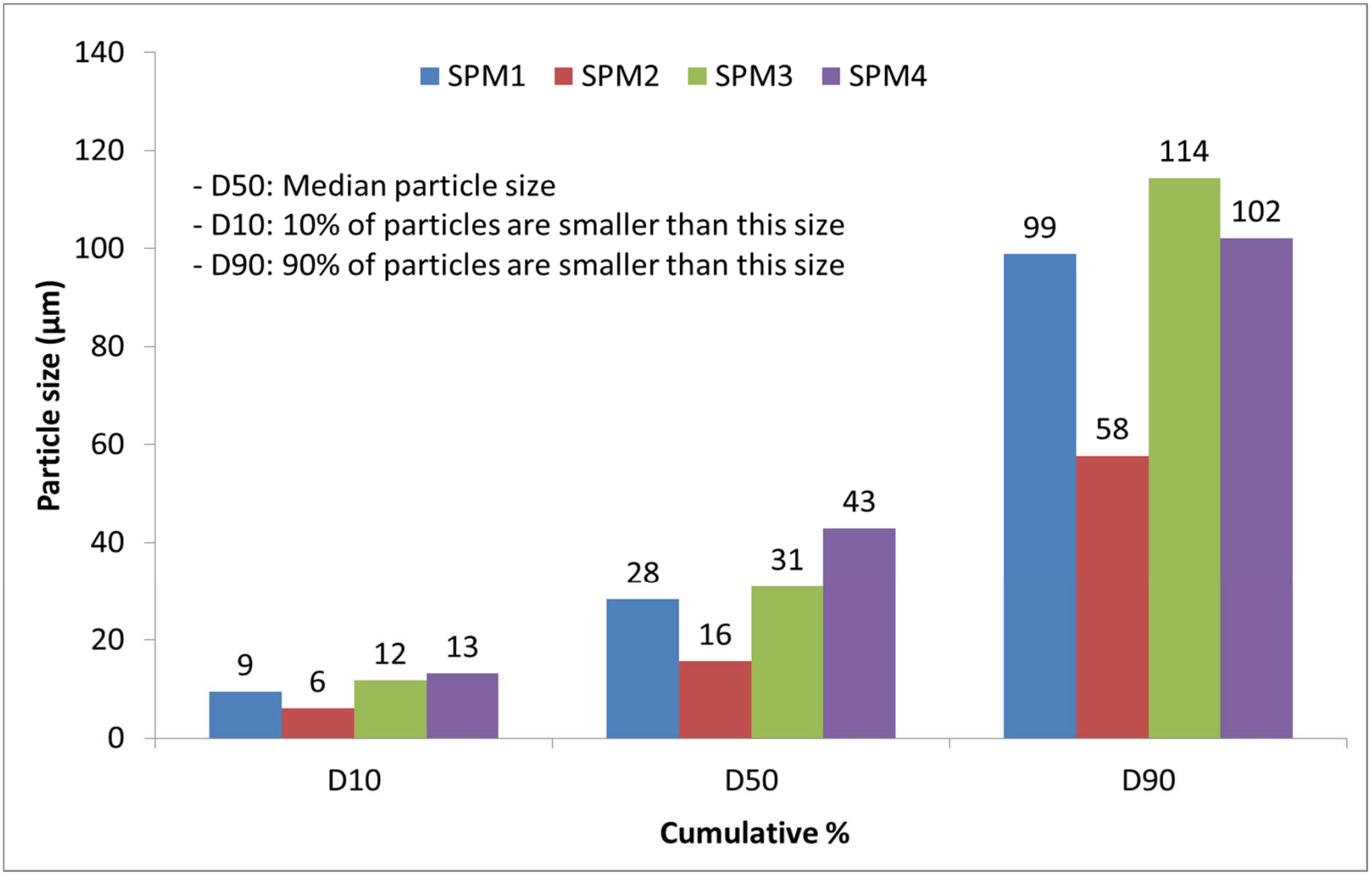
- **Separation by sedimentation**
  - **Non-homogeneous bulk; or**
  - **Crystalline silica density is greater than the rest of the bulk**

RESULTS AND DISCUSSION

- **Estimated crystalline silica (qualitative XRD):**
  - **SPM1 ± 3.0 %**
  - **SPM2 ± 3.2 %**
  - **SPM3 ± 2.1 %**
  - **SPM4 ± 1.2 %**

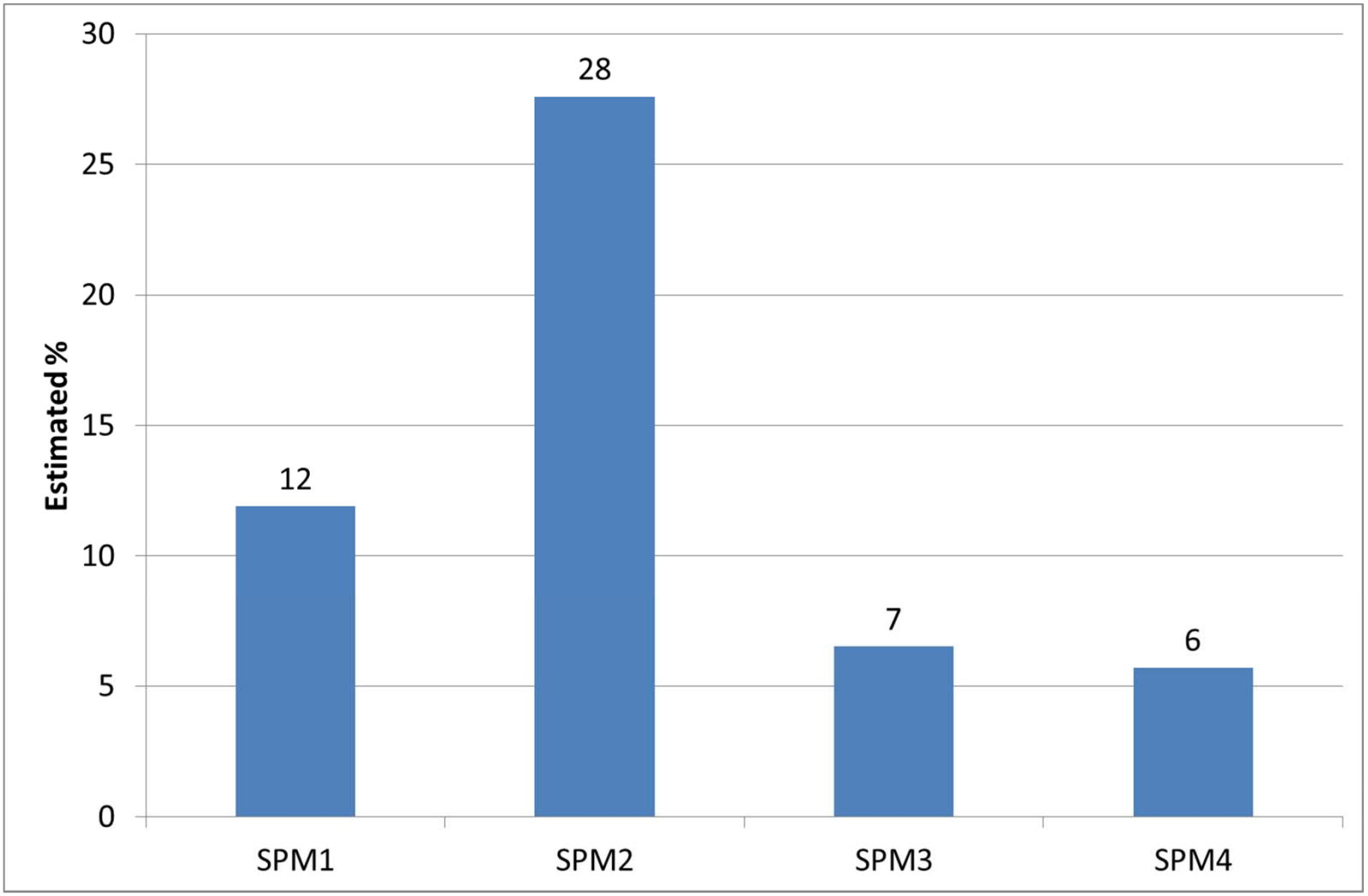
RESULTS AND DISCUSSION

- **Particle size distribution of bulk:**



RESULTS AND DISCUSSION

- **PM10 of bulk: Estimated % of sample below 10 µm**



RESULTS AND DISCUSSION

- **SWeRF by calculation (i.e. calculated fine fraction):**

Sample	Density (g/cm^3)	SWeRF calc Wt%
SPM1	2.39	0.3
SPM2	2.21	2.5
SPM3	2.80	0.1
SPM4	3.10	0.2

- **According to EN 481 => SPM2 potential risk**

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RESULTS AND DISCUSSION

- **SWeRF by sedimentation (i.e. isolated fine fraction):**

Sample	SWeRFsed Wt%	SWeRFcs Wt%
SPM1	0.5	6.1
SPM2	0.2	2.5
SPM3	1.3	41.9
SPM4	0.3	14.0

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RESULTS AND DISCUSSION

- **Particle size distribution on fine fraction:**

Sample	D10 (µm)	D50 (µm)	D90 (µm)	PM_{10} (%)
SPM1	0.6	1.4	5	93.3
SPM2	1.2	2.1	34	80.6
SPM3	0.2	3.5	9.5	91.5
SPM4	0.3	5	10.5	88.9

CONCLUSION

- **Bulk material contained < 2.5% fine fraction and < 3.2% crystalline silica**
  - ➢ **When made airborne, the fine fraction has 97.3% probability of entering the alveoli (EN 481)**
- **Isolated fine fraction (SWeRF): 6.1 – 41.9% crystalline silica**

RECOMMENDATIONS

- Risk assessment should include the materials used for support packs
- Release of fine dust during the disintegration of the support pack is over prolonged periods

WAY FORWARD

- **SWeRF method applications:**
  - **Material from waste dumps**
  - **Mineral ore**
  - **Unknown bulk material**
- **CSIR to investigate the slow release of dust during support pack disintegration**

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Thank you

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