

Some Characteristics of a Micro-Vacuuming Sampler for Removing Deposited Particles from Skin

L Lundgren¹, L Skare² and C Lidén^{2,3}

¹Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

²Department of Medicine in Solna, Karolinska Institutet, Stockholm, Sweden

³Department of Occupational and Environmental Health, Stockholm Centre for Public Health, Stockholm, Sweden

Background. Airborne skin exposure to allergens and irritants may cause dermatitis. There are few methods for assessing skin exposure to airborne particles. Vacuuming techniques have mostly been used for sampling from surfaces other than skin and have been regarded as poor collectors due to low removal efficiency [1]. A new micro-vacuuming sampler has been constructed by us and has been compared with other skin exposure techniques [2].

The present aim was to study some characteristics of this new micro-vacuuming sampler. Its sampling characteristics for different sizes of on skin deposited particles as well as its removal efficiency at different sampling airflows was evaluated.

Methods. Micro-vacuuming sampler: The sampler for removing deposited particles from the skin by micro-vacuuming can be seen in Figure 1. It consists of a three-piece 25 mm black filter cassette with a specially designed metallic nozzle (opening of 10 mm in length and about 1 mm in width). The device was connected to a stationary pump and sampling was done by moving the sampler repeatedly over the skin area.

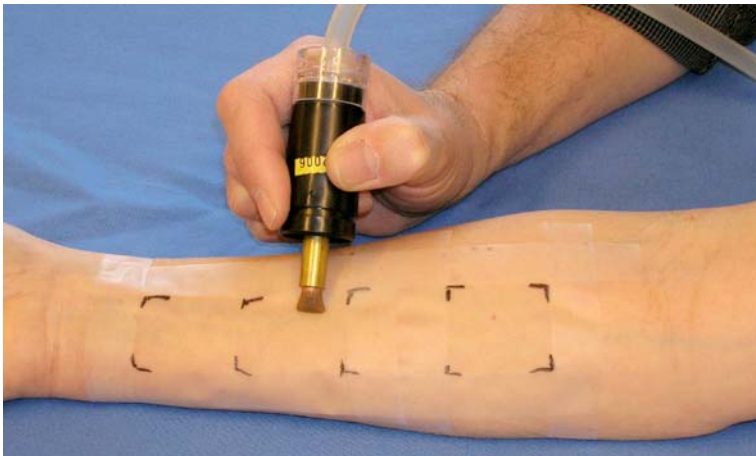


Figure 1. Micro-vacuuming on the skin.

Particles: Two particle size fractions of silica were investigated; <5 μm and 16-27 μm .

Exposure: The particles were deposited on human forearms in an exposure chamber for arms only. Three subjects participated. The study was approved by the Regional Ethics Committee at Karolinska Hospital, Sweden.

Study of particle collection inside the sampler: Particles collected after vacuuming in all different parts of the sampler (headpiece with nozzle, tube and membrane filter) were analyzed separately. The residue on the skin after vacuuming was removed and analyzed by tape stripping (Scotch Magic tape). Two exposure sessions with particles <5 μm (A and B) and two sessions with the fraction 16-27 μm (C and D) were performed. The airflow through the sampler was 5 l/min.

Study of different airflows through the sampler: All particles collected in the sampler (headpiece with nozzle, tube and membrane filter) were analyzed together. The removal efficiency was tested at three different airflows; 2, 5 and 10 l/min during six exposure sessions. Both particle fractions were studied.

Analysis: The amount of silica particles was analyzed with X-ray diffraction.

Results. The particle fraction found inside the sampler can be seen in table 1. Four exposure sessions (A, B, C and D) and two different skin areas (I and II) on the forearm were studied.

Table 1. Particle fraction found in sampler.

Sampler parts	Skin area	Fraction of particles found (%)			
		<5 µm		16-27 µm	
		A	B	C	D
Headpiece with nozzle	I	48	17	15	22
	II	29	16	25	25
Tube wall	I	7	13	46	36
	II	11	14	32	39
Membrane filter	I	33	58	39	42
	II	52	62	43	36

The removal efficiency for different airflows can be seen in table 2. Six exposure session and two different areas on the forearm were studied. The number within brackets is the number of tests performed.

Table 2. Removal efficiency at different airflows.

Airflow (l/min)	Removal efficiency (%)	
	<5µm	16-27µm
2	87 (1)	96 (1)
5	91 (4)	99 (2)
10	87 (2)	100 (1)

Conclusions. In the present design of this micro-vacuuming sampler, particles are collected not only on the membrane filter but also on the tube wall and the headpiece with nozzle. There seems to be no difference in characteristics for particle size. Evaluating only the amount found on the membrane filter will give a low and untrue vacuuming efficiency for this type of sampler. The removal efficiency (when particles from all the different sampler parts are included) at three different airflows is high, almost 90% and above.

Reference

- [1] Ashley K, Applegate GT, Wise TJ, Fernbeck JE and Goldcamp MJ, Evaluation of a standardized micro-vacuum sampling method for collection of surface dust, J Occup Environ Hyg, 4, 215-223 (2007).
- [2] Lundgren L, Skare L and Lidén C, Measuring dust on skin with a small vacuuming sampler – a comparison with other sampling techniques, Ann Occup Hyg, 50, 95-103 (2006).