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Measurement of Glove Permeation by Using an Instrumented Thermal and Sweating Hand

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Summary

The hand protection of soldiers working in extreme climatic or tropical conditions requires specific protective gloves that allow them to perform their mission. Protective gloves, that reduce sweat evaporation decrease their manual capabilities and their ability to manipulate small pieces. The instrumented thermal and sweating hand, is fitted to simulate human sweating characteristics. In addition to the measurement of glove permeation, it also allows to quantify precisely the maximal sweat transfert through technical gloves. This measurement allows to underline its contribution to the global insulation of the worn protective equipment. The test protocol allows to determine quickly the efficiency of sweat permeation through protective gloves. This sort of evaluation is an complementary and obligatory preliminary step before dexterity test on human subjects in laboratory.

1. Introduction

The hand protection of soldiers working in extreme climatic or tropical conditions requires specific protective gloves that allow them to perform their mission. Protective gloves that reduce sweat evaporation increase skin temperature and decrease their manual capabilities and their ability to manipulate small pieces.

2. Method

The instrumented thermal and sweating hand is fitted to simulate human sweating characteristics. In addition to the measurement of glove permeation it also allows to quantify precisely the maximal sweat permeability through technical gloves. This measurement allows to underline its contribution to the global insulation of the worn protective equipment.

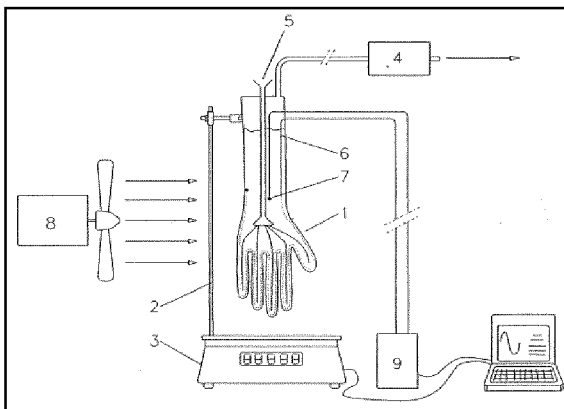


Figure 1 : Principle of the measurement



Figure 2 : The measurement system

A porous porcelain hand containing clean water is heated and regulated by a computer. The part of water evaporated through the artificial hand is continuously weighted and monitored by the computer.

Technical parameters		Measurements	
Ambient temperature	24±0.5 °C,	Heating power (Watts)	
Humidity	40±5%	Heat flow (W/m²)	
Simulated core temperature	37±0.5°C	Total evaporated water (g)	
Wind speed	< 0.30 m/s	Sweat rate (g/h)	
		Skin temperature (°C)	

3. Results

The sweat evaporation flow of different concepts of gloves were tested with the thermal and sweating instrumented hand in comparison with the naked hand : butyl, butyl with cotton under-gloves and four models of new generation permeable gloves.

	bare hand	Butyl	Butyl Ug cotton	NBC type G	NBC Type W	NBC Type v 3	NBC Type v 4
Skin temperature	33.1±0.1	34.4±0.2	34.7±0.5	30.7±0.2	32.7±0.7	32.5±0.1	34.3±0.1
Evaporated Water (g/h)	46.8±0.6	1.1±0.4	1.0±0.4	18.2±1.3	16.0±1.1	16.7±1.3	15.4±0.9

Table 1 : Skin temperature and evaporated simulate sweat through gloves.

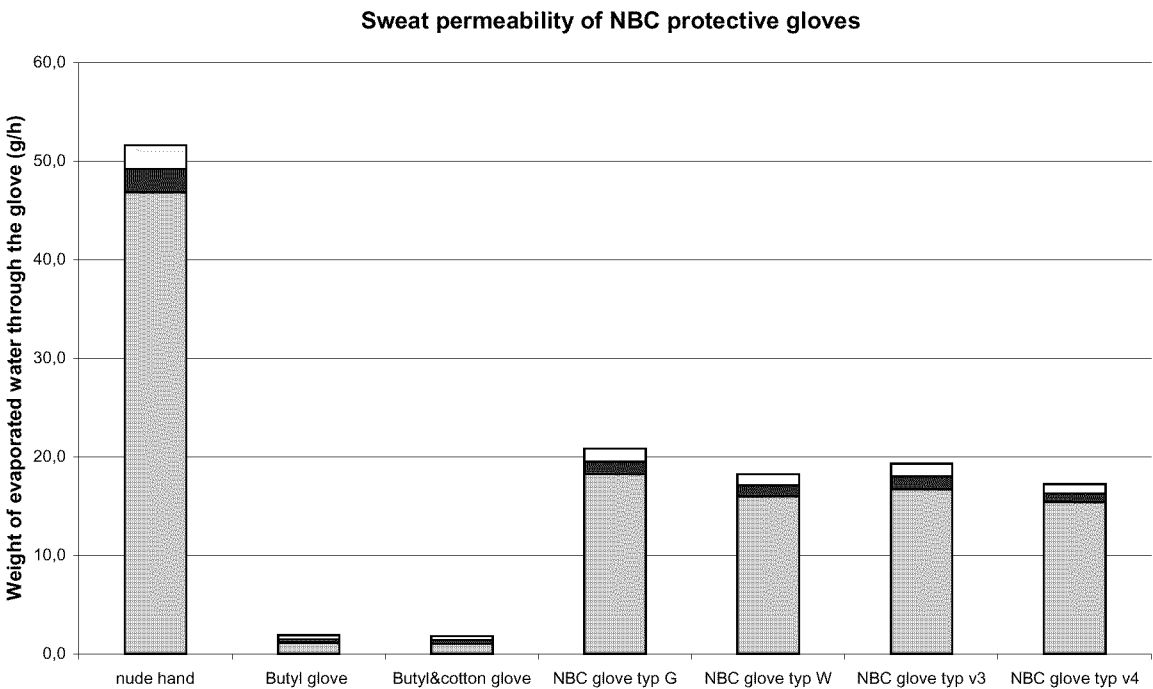


Figure 3 : Sweat permeability through protective gloves

4. Conclusions

The test protocol allows to determine quickly the efficiency of sweat permeation through protective gloves. The sweat evaporation is strongly limited by the butyl glove but in comparison with the naked hand, all NBC permeable protective gloves allow the half natural flow rate.

This type of evaluation is a complementary and obligatory preliminary step before dexterity tests on humans in laboratory.