CLOTHING AS A FACTOR REGULATING SOLAR HEAT LOAD IN MAN

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INTRODUCTION

Studies performed by Nielsen (1990) indicate a clear influence of colour and insulation of clothing on absorption of solar radiation as well as on the direct physiological response of an organism, i.e. changes of skin temperature and body heat content. The paper presents results of investigations dealing with absorption of solar radiation and its transfer through different fabrics in still and moving air.

METHOD

Absorption of solar radiation and its transfer through different fabrics were studied with an ellipsoid human body model. Measurements were taken in a climatic chamber using an iodide solar lamp and two ellipsoid sensors of the PMV meter (Bruel&Kjaer 1212). One sensor was uncovered and the second was covered by different fabrics with albedo values of 3-95% and insulation values of 0.2-1.1 clo. An absorbance index (Abs) was estimated as a ratio of absorbed solar radiation observed at covered ellipsoid in still and/or moving air to its value measured with the uncovered ellipsoid in still air.

RESULTS

The rate of solar radiation absorbed by the uncovered ellipsoid varied from 60 to 90 W m^{-2} depending on elevation of solar lamp. The amount of solar radiation absorbed by the covered ellipsoid strongly depended on the physical properties of the used fabric assembles as well as on "sun" altitude (Fig. 1).

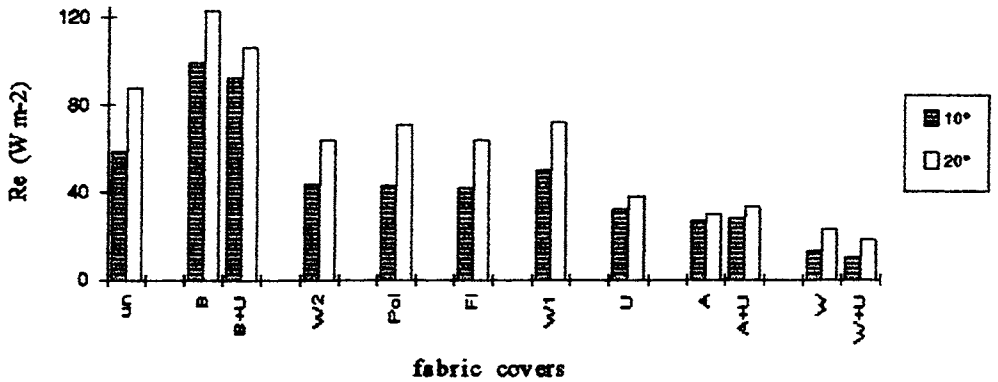

Fig. 1. Solar radiation absorbed by the uncovered and covered ellipsoid
10° and 20° - elevation of solar lamp; explanations of the symbols of fabric covers in Table 1

It was noticed that the rate of absorbed solar radiation depended mainly on albedo of used fabric (Table 1). The Abs index varied form 0.16 for white asbestos cover (albedo of 95%) to 1.74 for black asbestos fabric (albedo of 3%).

Table 1. The Abs indices observed for different fabrics assembles in still air

Fabric assemble	Symbol	Insulation (clo)	Albedo (%)	Abs index at "sun" altitude of 10°	20°
uncovered ellipsoid	un	0.59	30	1.00	1.00
cotton underwear	U	0.22	50	0.54	0.40
polyester	Pol	0.20	30	0.72	0.81
flannel	Fl	0.32	30	0.71	0.73
wool (1.5 mm thick)	W1	0.54	30	0.85	0.82
wool (2 mm thick)	W2	0.57	25	0.74	0.72
black asbestos	B	0.36	3	1.74	1.40
black asbestos + underwear	B+U	0.43	3	1.55	1.21
white asbestos	W	0.36	95	0.23	0.25
white asbestos + underwear	W+U	0.43	95	0.16	0.18
aluminium foil	A	1.02	90	0.46	0.34
aluminium foil + underwear	A+U	1.06	90	0.46	0.38

Air motion reduced absorption of solar radiation both for covered and uncovered ellipsoid. The biggest decrease of the Abs index was observed for flannel and the smallest one for polyester cover (Fig. 2).

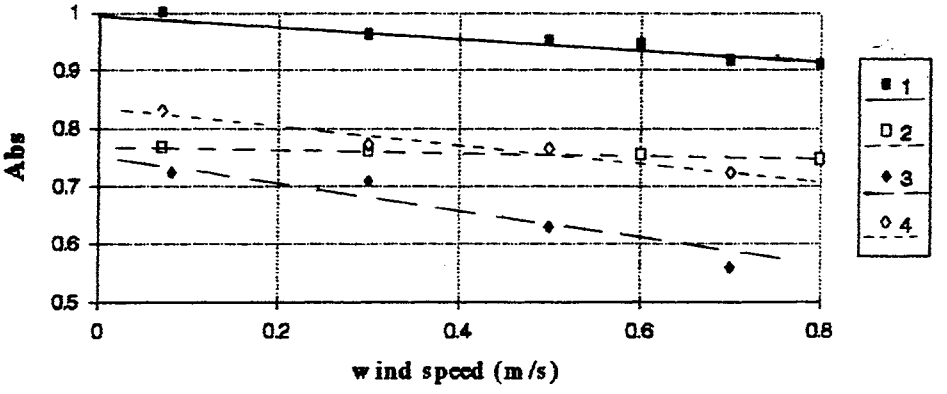

Fig. 2. Influence of air motion on Abs index;
1- uncovered; ellipsoid covered by: 2 - polyester, 3 - flannel, 4 - wool, 1.5 mm thick

CONCLUSIONS

Absorption of solar radiation depends on albedo of fabric, fabric insulation and air motion. These factors should significantly influence heat balance of man outdoor and his thermal comfort.

REFERENCES

Nielsen B. 1990, Solar heat load: heat balance during exercise in clothed subjects, *Eur.J.Appl.Physiol* 60, 452-456.