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ELECTROSTATIC CHARGE IN OFFICE ENVIRONMENTS.

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Abstract

Health disturbances associated with work in "clean" environments are diffuse and diverse, but irritation in the face, eyes and upper respiratory tract is often reported. The etiology of these complaints are probably multifactorial. Theoretically, electrostatic charge could induce attraction of airborne dust. This study was performed to find out if electrostatic phenomena could be one of the factors causing indoor work-related discomforts. The whole staff or a randomized part of the staff (108 persons in total) from four offices was included in the study. Interviews, examination of the indoor climate and measurement of the potential differences between each person and an earthed reference point were performed. The potential differences were moderate, and the offices were clean and well-ventilated. Under these conditions no significant correlation was observed between the potential difference at ordinary work and the occurence of work-related discomforts.

Introduction

Theoretically, the electrostatic charge of persons working on isolating floors might cause attraction of airborne dust in a similar way as, i.e., electrostatic dust filters. This investigation was performed to test if electrostatic charge could induce or exaggerate local irritation in face and upper respiratory tract.

Material and Methods

In four large offices either the whole staff or a random-

ized part of the staff (in total 108 persons) was interviewed. Concurrently, the temperature, the relative humidity of the air and the electrostatic charge of each interviewed person were examined.

The interviews were standardized and included questions about irritative symptoms from the skin, eyes, respiratory tract, and also general symptoms such as tiredness, headache and nausea. Any time relations between office work and the occurrence of symptoms were noted. The reported symptoms were regarded as work-related if they commenced during the working hours and disappeared within 1-2 days after discontinuation of the work. Immediately after the interviews the examined persons reported their subjective conception of work satisfaction and of five different environmental factors (temperature, air humidity, lighting, dustiness and draughtiness) on visual analogue rating scales (4). At the same time the air humidity and temperature were measured with an Assman psykrometer.

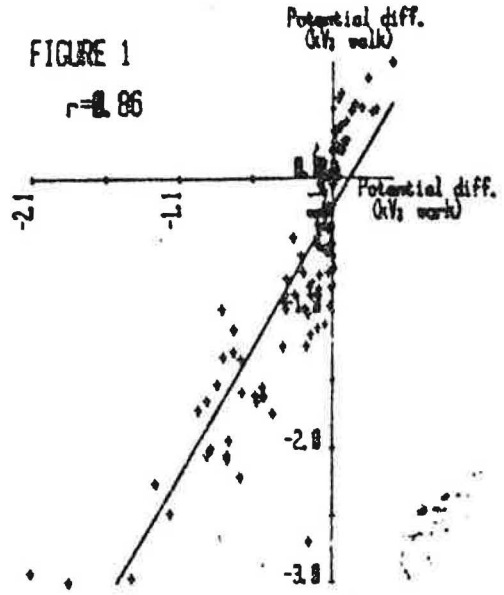
Measurements of the voltage between every examined person and an earthed reference point were performed during five minutes of ordinary work and during two types of standardized activities, viz. rubbing of the back against the chair seat and walking in the work room. The measurements were performed with a rebuilt field-strength meter (Eltex O 475 C) coupled to an electrode attached to the wrist of the examined person. The responses were continuously registered on a chart recorder and on an electronic data logger.

Statistical analysis has been performed with two-sided Student's t-test, 4-field tables to which Fisher's exact test (one-sided p-value) was applied, and regression analysis.

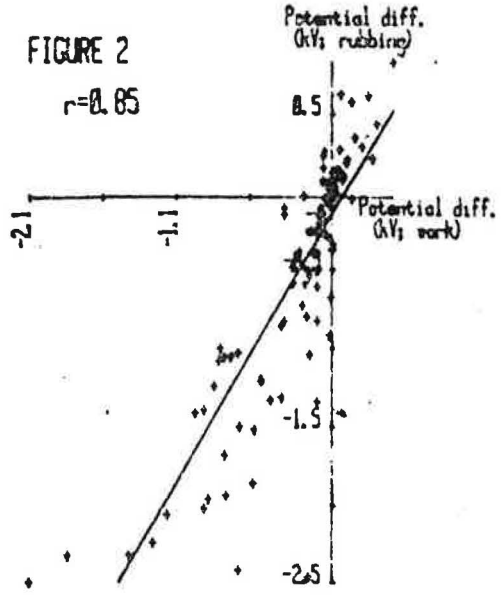
Results

As appears from figures 1 and 2 there is a close correlation between the voltages induced by ordinary work on one hand, and by a walk in the office room or by rubbing the back against the seat of the work chair on the other. There is a considerably weaker, but still highly significant ($p < 0.001$), correlation between the mean voltage at work and the relative air humidity. Decrease of the air humidity tends to increase the potential difference between man and earth (figure 3).

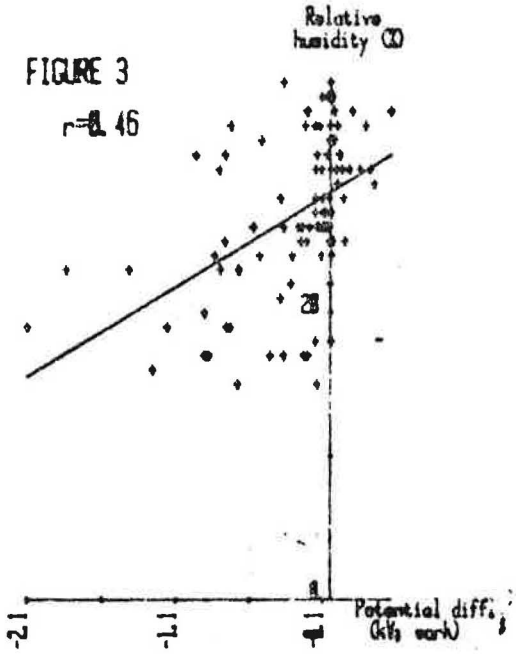
The mean potential difference between man and earth was 0.41 kV in rooms equipped with close-fitted carpets as



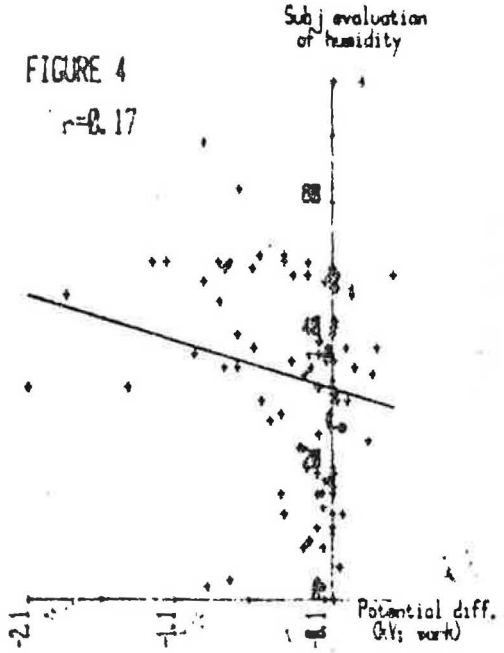
Correlation between mean potential differences at work and at a short walk in the work room.



Correlation between mean potential differences at work and at rubbing of the back against the chair seat.



Correlation between relative humidity and mean potential differences at work.



Correlation between subjective evaluation of the humidity and mean potential differences at work.

Table 1. Correlation between the potential differences and the occurence of irritative symptoms in face, eyes and upper respiratory tract.

		Voltage <0.5 kV	Voltage ≥0.5 kV
Irritative symptoms	No	31	8
	Yes	55	14

Fisher's p = ~~0.061~~ 0.61

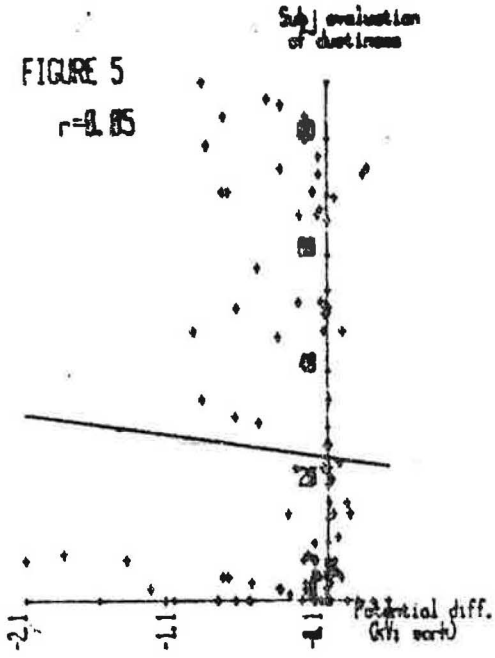


FIGURE 5

Correlation between subjective evaluation of dustiness in the work room and mean potential differences at work.

compared with 0.07 kV in rooms with other flooring materials. This difference is significant ($p < 0.001$). However, no significant relation was observed between these potential differences and the occurrence of work-related symptoms in the eyes, face or upper respiratory tract (table 1). Nor are there any significant correlations between this potential difference and the subjective evaluation of air humidity (figure 4) and dustiness in the room (figure 5).

The maximal peak potential differences between examined persons and the earthed reference point during ordinary work were on the positive side 1.76 kV and on the negative side -3.78 kV.

Discussion

Health disturbances associated with office or dwelling environments are diffuse and diverse. However, irritative symptoms from the eyes and upper respiratory tract are often reported. The etiology of these complaints is probably multifactorial, and chemical, physical, microbiological and psycho-social factors have been proposed as possible causative agents. Paradoxically, complaints are often reported from people working or living in new-built rather than in old localities.

It has been supposed that electrostatic phenomena due to the use of video terminals (3,7) and electrically isolating flooring materials (2,5) could promote the occurrence of discomforts. From a theoretical point of view, it seems reasonable that airborne particles could accelerate in the electric field around an electrostatically charged individual. Particles moving towards him ought to impact especially on protruding parts of the body, such as the nose and the area around the eyes. Thus, a combination of large field strength and high concentration of airborne dust might induce irritation in these areas. It is known that exposure to inert dust in connection with handling of paper could result in itching and redness of exposed skin areas, and that persons with a low itch threshold are especially sensitive in this respect (1,6). It is not known if electrostatic phenomena contributes to this effect, but an increased prevalence of "dry throat" in teachers working in schools equipped with close-fitted carpets has been reported (5).

In two of the examined offices, the mean potential difference between man and earth was constantly below 0.5 kV, while somewhat higher mean voltages were noted in the

other two offices. The prevalence of irritative symptoms were about the same in both groups of offices indicating that potential differences of a few kV are without importance in this context.

The results do not support the hypothesis that static electricity plays a notable role as indoor irritant in office environments. It is, however, possible that electrostatic phenomena might have some influence when higher voltages than observed here are combined with dust-producing activities. The material hitherto examined is small, the registered potential differences were moderate and the work environments were clean and well-ventilated. A spin-off observation was that the potential difference between man and earth at office work could be reproduced in simple and fast tests, such as a short walk in the work room. This could facilitate further studies of electrostatic phenomena in indoor environments.

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