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PRINCIPLES AND METHODS FOR CONTROL OF AIR POLLUTION IN HEALTH RESORTS

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INTRODUCTION

An essential part of the beneficial effects of cures in health resorts can be attributed to the transfer of the patient to an environment promoting recovery to good health. And among the environmental components the air quality is certainly an important one.

The procedure for qualification of a place as a health resort included regulations to ensure freedom from air contaminants as early as in 1963 (1). An attempt had been made to define the permissible pollution at 20 or 40% of the concentration limits for gaseous pollutants set by the German "TA-Luft". In practice, however, these regulations have never been executed, mainly because neither the financial means nor the manpower and equipment for measurement were available. The only expedient for getting some control over the air quality had been a primitive system of dust sampling and evaluation.

MEASURING METHOD

New developments in passive sampling methods of gaseous pollutants have changed the situation. For instance, the technique of Surface Activated Monitoring (SAM) adopted by the "Umweltbundesamt" (4) promised to satisfy many of the requirements for practicable air quality control in health resorts. Some of these special requirements are:

* Very low detection limits * Independence from electric mains supply * Minimal demands on attendance for the sampling devices * Bearable costs of equipment and analytic procedures even for long periods of monitoring and many sampling locations.

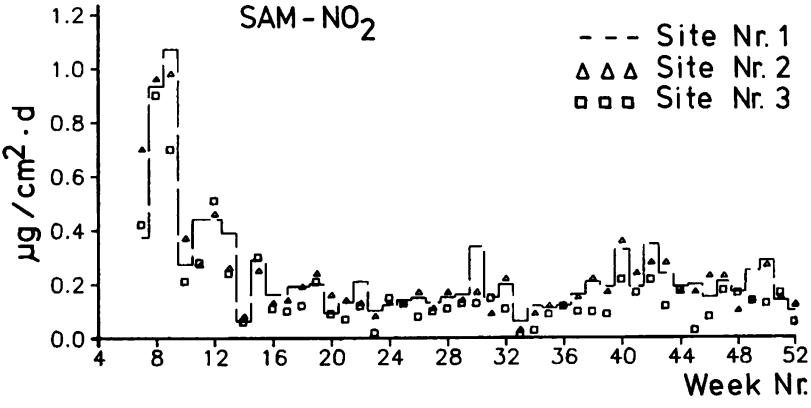
However, the before mentioned technique , using glass fiber filters soaked with potassium carbonate as absorbent for airborne gases, is limited in its usefulness for evaluation of air quality in health resorts by the following properties: * A sampling period of 4 weeks, reducing the possibility of analyzing the influence of weather conditions and of transitory emission events * A strong dependance on wind velocity of the gas deposition rate on the probe which had not yet been quantitatively examined. * Lack of experience about the correlation between concentration in the air and deposition on the SAM-probes for other substances than sulfur dioxide. Apart from heating, motor vehicles are the prevailing source of air pollution in health resorts. That is why there is also a strong need for some means of measuring nitrogen oxides.

The results of a 3 years effort to overcome as much as possible the limitations can be shortly summarized as follows (3): 1) As a consequence of refinements of the analytical procedure, adequate precision of the results can be obtained even in a locally uncontaminated environment with sampling periods of one week. 2) Oxidative pretreatment of exposed samples before the ion chromatographic analysis overcomes some difficulties originating from the fact, that nitrogen dioxide is caught partly as nitrite, partly as nitrate. 3) The dependance of the sampling rate on ventilation of the probe has been determined in the laboratory. When applied to measurements in the field, an approximate correction for the local ventilation can be applied.

Comparative tests at several continuous monitoring stations were performed for at least one year with these modifications . The air quality at the stations covered the range from almost background contamination to the situation amidst a large town. The conformity between weekly pairs of SAM and concentration data proved to be sufficient for correct reproduction of the seasonal trends as well as of weather dependent episodes of changing air pollution. The correlation coefficient between yearly means amounts to 0.94 for SO_2 as well as for NO_2.

Fig.1 gives an example of the information obtained from a series of measurements at 3 sites of a health resort. The main immission peaks are not produced locally, they are caused by transportation of contaminants from distant sources.

Fig.1 NO_2 Immission Rates at 3 Sites of a Health Resort derived from 1-week Expositions of SAM-Probes. 1 = Traffic Center, 2 = Residence Area, 3 = Area for Open Air Therapy



In order to further improve the method toward less dependance on ventilation, we are just testing a diffusion controlled modification of sampling.

EVALUTION OF AIR QUALITY

Having obtained a means for estimating the air pollution level at several sites of a health resort, the next question is how to differentiate between admission or rejection of a claim for qualification.

To that end a classification score on the basis of the 1-year mean and the 95 percentile of a measuring series at representative sites of the place has been established between two bonds: A lower one - marked by a score of zero is equivalent to the concentration level at background stations - and an upper one with a score of 4 is equivalent to the limits of the widely accepted guideline "VDI 2310", extrapolated to a sampling period of one week. The following tables shall give an insight to the system of classification:

Table 1: Scores of Air Quality and yearly Concentration Averages

	SO_2		NO_2	
0 = virtually pure air				
1 = hardly perceptible contamination	up to	15	up to 12	ug/m³
2 = low contamination	" "	25	" " 20	"
3 = moderate contamination	" "	50	" " 40	"
4 = population tolerance limit	" "	100	" " 80	"
5 = very high contamination	exceeding	100	exc. 80	"

The rules (2) for approval of an appropriate air quality are shown in condensed form in the next table:

Table 2: Requirements of Air Quality in different Areas of Health Resorts

	Maximum Scores for		
	Traffic Center	Residence Center	Open Air
Thermal Stations	4	3	2
Thermal Stations for Respiratory Diseases	4	2	2
Climatic Stations	3	2	1

The requirements are graduated according to the therapeutic objective of a station. The most exacting conditions are imposed to the surroundings of climatic stations, but even watering places should always have at least one area of particularly good air quality. Within the next years, all existing health resorts in Germany will be checked for air quality according to the measuring and classification system described.

SUMMARY

Early attempts to set air quality standards in German health resorts had suffered from a lack of practicable methods for longtime measurement of air contaminants in several areas of each station. Therefore, a passive sampling technique (SAM = Surface Activated Monitoring) has now been adapted to the special requirements. SO_2 and NO_2 immission rates are determined by series of 1-week exposures covering at least one year.

The results allow a classification of air quality by 5 scores in the range between background contamination and the limits of guideline VDI 2310. They are forming the basis of new regulations of the "Deutscher Bäderverband". Permissible maximum scores are differentiated according to the therapeutic objective of a station and to the importance of the area of measurement for the patients. A short outline of the regulations is given. All German health resorts are obliged to have checked their air quality using this system of measurement and evaluation.

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