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Situation of Environmental Measuring System in Germany

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Situation of Environmental Measuring Systems in Germany

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<Abstract>
As we approach the 21st century, we find our earth facing various environmental problems. This paper describes the environmental measuring system in Germany as one of the most intensive measuring air quality in Europe, and introduce the HORIBA's advanced air quality monitoring systems.

1. Introduction

Pollution of the ambient air in many cases do not cause a harmful consequence immediately to human beings, the nature or to materials, but over a longer time.

In those cases the effort for a pure air requires idealism and an ethical consciousness, based on the idea to preserve the nature with all is beauty for himself and the future generations.

At this, the environment protection should be not only demanded by others, but in particular imprinted by an exemplary personal way of acting, too.
The expression "Life Quality" will undergo a change in its meaning. Instead of the improvement in life style and the aims towards material technical merits, other factors like health, wellness and the preservation of nature and environment will step to the foreground as important fundamental values of our life.

This paper describes the environmental measuring system in Germany as one of the most intensive measuring air quality in Europe.

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ドイツにおける大気環境測定システムの状況

1. はじめに

大気汚染は，人間や自然や物に対し必ずしも急激な変化はもたらさないが，長い年月にわたると悪影響を与える．そこで，きれいな大気を後世に伝えたいという動きがでてきた．環境保護は，他からの要求だけではなく，自発的に行動されるべきものだ．クオリティ・オブ・ライフの意味するものは，生活習慣の変革や物質主体ではない，健康や自然保護に基本的な価値を見出そうとすることである．本稿では，ヨーロッパの中でもとくに厳格なドイツの大気環境測定システムを紹介する．

2. 大気汚染状態の測定

ドイツには，大気環境保全に関する法令としては連邦大気汚染防止条例 (BlmSchG：Federal Immission Control Act) があり，中でも次の二つが主体である．

2. Monitoring of Air Quality

The authoritative law for air quality control in the Federal Republic of Germany (FRG) is the Federal Immission* Control Act (BlmSchG). The regulations of this law cover virtually all areas of ambient air quality control are complied in Appendix 1.

The following regulations will be considered for ambient air quality control :

- the Technical Instructions on Air Quality Control (TA–Luft), the 4th General Administrative Instruction on monitoring of Ambient Air Quality in Examination Areas.
- the Smog-Regulations of the Federal States.

Furthermore there are measurements with specific intentions like wide area investigations, border-exceeding transportation of air pollutants or the conjunction of forest damages and air pollution.

* **Immission**
A German term for which there is no simple English equivalent, means "Air pollutants, noise, vibrations, light, heat, radiation's and analogous environmental factors affecting human beings, animals, plants or other objects"

3. Significance of the place of measuring station

In case of air pollution measurement it has to be differentiated between mobile measurements with measuring vans and stationary measurement with measuring container.

In case of mobile measurements the measuring is done punctually at always changing places in order to determine the geographic distribution of the air pollutant. In case of stationary measurements the temporarily distribution is measured continuously.

The stationary measurements have to be proceeded at a representative place of the area which is to be checked. For this the geographic distribution of the air pollution which is determined regularly-generally according to the regulation "TA-Luft" with mobile measurement has to be known.

Mobile measurements are also used:

- At measuring locations that are not covered by stationary measuring station
- For the reference measurement to existing measuring systems
- For the measurement of the spread of harmful substances
- For the determination of the cause of air pollutions
- For special measuring programs

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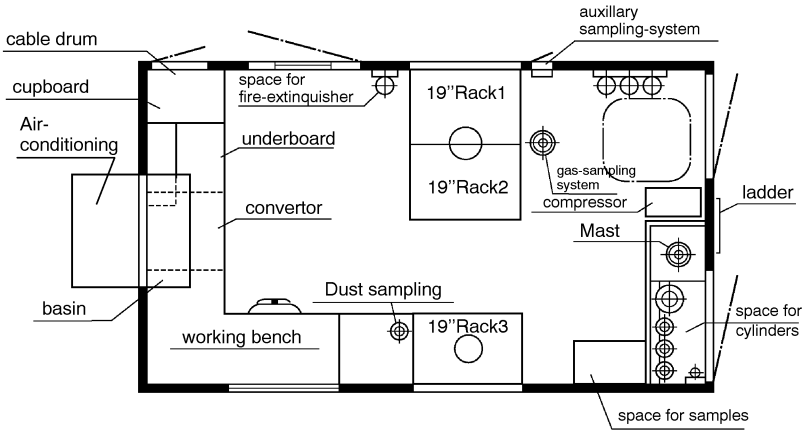
① 大気環境測定に関する技術指針(TA-Luft)および第四次環境測定指針
② 連邦政府のスモッグ規制
さらに，大気汚染物質の広域移動や森林破壊などを対象とした指針がある．

3. 測定局設置場所の選定

大気汚染の測定は，固定局(コンテナ)および移動局(自動車)で行われる．
移動局では場所を変えて測定し，固定局ではTA-Luftに基づき決められた場所を順次測定することにより，大気汚染の広がりを調査する．
さらに移動局は次の目的にも使われる．

- 固定局でカバーできない地域の測定
- 既存の測定システムの参照用
- 有害物質の拡散状態の測定用
- 大気汚染源の特定用
- 特別な測定プログラム用

Atmosphere monitoring vehicle (shipped to Rusia)



Internal view of the atmosphere monitoring vehicle

4. Regulations regarding the selection of the place and the construction of automated measuring stations in telemetric air quality measuring network

To have the same criteria with regard to the choice of the place and the construction of the measuring networks of the states following regulations have been made:

(1) Rules for the choice of place for air quality measuring stations:Table1

1. Cartographic place	The measurement station shall be arranged in network of constant grid width(1km), North-south/east-west direction
2. Distance to larger obstacles	no less than double the height of the obstacle or the width of the obstacle
3. Measuring height from ground	below a level of half of the mean building height
4. Distance to local source	In order to minimize the effects of local sources , the distance from industrial and domestic sources and from highly frequented roads shall be at least 20m. At individual source, it must be checked to see if the minimum distance is sufficient.
5. Free stream	Obstacles to free flow are not allowed to be within 10m. Sampling at lateral surfaces of buildings must be avoided in principle.
6. Local circulation	Interference dependent on topography must be ruled out.

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4. 大気汚染観測網の測定点選定と自動測定局の構成

(1) 大気汚染観測網の設置場所の選定基準 (Table1)
1. 測定局の配置，2. 障害物との距離，3. 測定地点の高さ，4. 汚染発生源からの距離，5. 測定空間の限定，6. 地形の影響

(2) 測定局の構造 (Table2)
1. 通則，2. 安定性，3. 断熱性，4. 空調条件，5. 落雷対策，6. 機器構造，7. 電源，8. 安全対策，9. ガス配管，10.排ガス処理

(3) サンプリングシステムの構成 (Table3)
1. サンプリング・ヘッド，2. マニホールド，3. ガス流量，4. 遅延時間，5. 分析計の接続順番，6. 洗浄間隔

(4) 分析部とデータ通信システム間のインターフェース (Table4)
1. 電源の取合い，2. インターフェース，3. アナログ出力，4. 出力インピーダンス，5. 状態信号

(2) Requirements regarding the construction of the measuring stations:Table2

1.	General	The measuring station must meet the rules and regulations on construction and safety engineering. Moreover the regulations on noise control must be observed.
2.	Stability specifications	Roof load > 750N/㎡, Ground load > 3000N/㎡
3.	Temperature isolation	< 2W/㎡K
4.	Air conditioning	+15℃ to +30℃, < ±5K
5.	Lightning protection	
6.	Construction design	Non-flammable material, Instrument 19-Module
7.	Electronic feature	4 different and separate circuit must be provided
8.	Security control	Measuring station functions are able to transmit
9.	Gas piping	self-sealing standard screw joints to be used
10.	Exhaust gas treatment	discharged safety from the measuring station

(3) Requirements regarding the construction of sampling systems for gaseous components:Table3

1.	Sampling head	Fixed designed, D=14cm, da=4cm, stainless steel
2.	Sampling tube	made by borosilicate-glass, diameter 20 to 40mm
3.	Volume flow capacity	minimum 10 times higher than sample gas consumption of all analyzers, flow monitoring at outlet point
4.	Duration	Max.10sec.
5.	Connection of measuring instrument	according to the reaction of substances, O_3 > NO_x > SO_2 > H_2S > C_nH_m > CO
6.	Cleaning	6 months cycle

(4) Requirements regarding the interfaces between analyzers and data communication systems:Table4

1.	Electric connection	AC 230V Euro-plug
2.	Interface	50-pin Sub-D or RS-232C
3.	Analog signal	0(4)-20mA
4.	Load	< 600 Ohm
5.	Status signals	displayed

For the usage of measuring analyzers in the above mentioned measuring stations there are also technical minimum requirements but we will not go into detail.

分析計の取扱いに関しても他に規定されているが，詳細は割愛する．

5. 校正

分析計の校正は，測定の信頼性を左右する重要因子である．

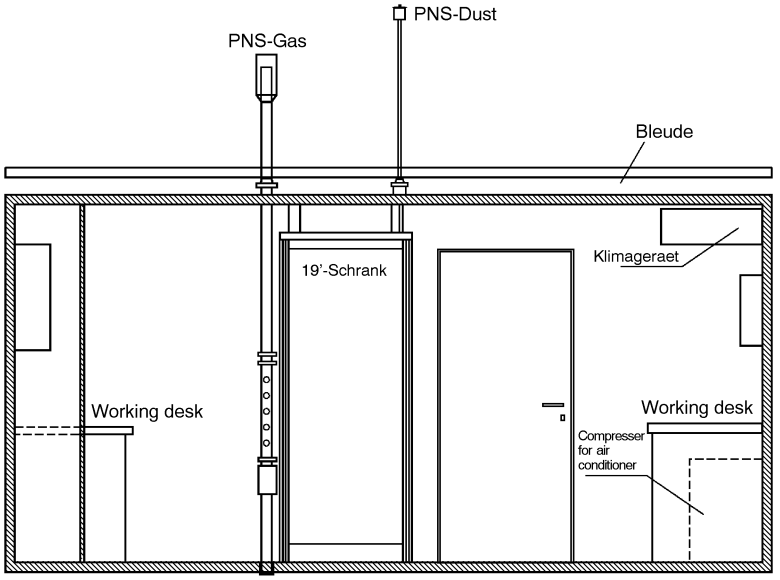
最近，校正技術は急速に向上しているが，これには，各測定局の作業者からの要望，ドイツ環境庁(UBA)による環境研究ならびに行動計画，VDI委員会のガイドラインなどが大きく寄与している．

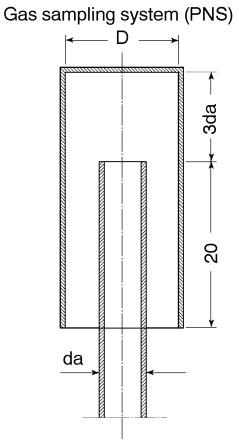
5.1 標準ガス

分析計の校正用標準ガスは，次の手法で調製される．

- 質量測定を用いたパーミエーション・チューブ法
- 質量比混合法に基づく方法
- 体積混合法に基づく方法

二次標準ガスは，ガス希釈法，とくにキャピラリー，クリティカル・オリフィス，オリフィス，マスフローコントローラー，パーミエーション・チューブ法などにより作られている．ガスボンベの内面加工の進歩により標準ガスの安定性が





Atmosphere monitoring station and sampling system

5. Calibration

Another important element for the reliability of measuring results is the calibration of measuring instruments.

Recently the calibration technique developed quickly. Important contributions were given by the requests of the measuring network-operators. Also the results of the Environmental Researching schedule, the activities of the German Federal Environmental Agency (UBA) reference laboratory and the guidelines of the VDI commission contributed a lot.

Because of the usage of new techniques and materials, the blending of gases and the conservation could be improved very much.

5.1 Standard gas

Important methods to produce primary span gases are currently:

- *Permeation with gravimetric determination*
- *Methods based on blended gravimetric measurement*
- *Methods based on blended volumetric measurement*

改善されている．

5.2 リファレンス法

ドイツでは，大気質測定の信頼性に関し，リファレンス法(基準測定法)が認証されている．各州の専門家達の意見を基に，①リファレンス法の決定，②等価法の選択，③校正方法の原理などのガイドラインが策定されている．

リファレンス法は標準ガスによる確証のために使い，現場ではこれと等価な方法が使われる．認証取得結果は，GMBLによって公表される．

5.3 校正用ガス

測定局でよく使われている校正用ガスをTable5に示す．

6. ホリバ・ヨーロッパのアクティビティ

ホリバは，このような広範囲な要求に対応すべく，15年以上の経験に基づき，要求仕様を満足し，実用的かつ完璧なシステムの提供を約束する．現在，高感度で信頼性の高い分析計が数百もの大気汚染観測システムに使われており，大気質研究に大いに貢献している．

(抄訳　編集部)

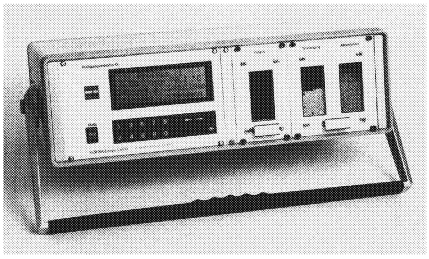
Secondary span gases are made out of premixing with dilution systems or mixing systems. For this among others capillaries, critical orifice, orifice, mass flow controllers and permeation systems without gravimetric determination are used.

Special surface coverage of the inner walls respectively the frequent usage of aluminum has improved the stability of testing gases in pressure cylinders a lot. After the admission of aluminum cylinders also in Germany, German manufacturers could compensate the technological advantage of foreign manufacturers.

In spite of these progresses the stability of testing gases in pressure gas cylinders is not sufficient for all components and calibration purposes. When operating the pressure gas cylinders for round robin tests and as transfer standards, the concentration has to be checked. This is done through comparison with primary standards or with reference procedures in specially designed calibration laboratories.

5.2 Reference methods

Regarding the monitoring of air quality and for the reliability of measuring results, reference methods are a further important basis to guarantee a homogenous measuring method in Germany.



O_3 standard gas generator

Based on extended research and discussions of experts of the countries, corresponding guidelines have been developed:

- *the determination of reference methods*
- *the choice of equivalence methods*
- *the principles of calibration methods*

Reference methods are basically used to verify the calibration by using the standard gas. For field measurements equivalence methods are used. With the equivalence methods the practical air quality measuring is proceeded according to reference methods. The results have to be published in GMBL to get the approval.

5.3 Calibration gases

Often used methods at measuring stations are following Table 5

Component	Zero gas	Testing/Calibration gas
SO_2	Synt. Air Scrubber	calibration gas bottle, mainly permeation
NO_2	Synt. Air Scrubber	Gas phase titration (GPT) NO-gas bottle NO_2-permeation with NO_2/NO converter
O_3	Scrubber	UV-lamp
CO	Synt. Air Scrubbe	CO-calibration gas bottle
C_nH_m	Synt. Air	CH_4-Calibration gas bottle CH_4/C_3H_8 calibration gas bottle

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6. HORIBA Europe activity

The logical consequence of above comprehensive requirements was the provision of complete system solutions for this specific measuring task.

Based on our experience of more than 15 years in this special field, we can refer to an innovative development of efficient, practical and perfectly aligned systems.

Together with our sensitive and reliable monitors, that are in use in several hundreds of air pollution monitoring systems, our standard of quality and the precise measurement could set new standards in the environmental technology, that assist the experts in their investigation of today's ambient air quality.