Design Guide Book (DGB) of Industrial Ventilation

Tähti E
Finnish Development Centre for Building Services Ltd, Helsinki, Finland

Technology Programme INVENT took place in Finland from 1991 to 1996. In this programme over 100 R&D projects were completed and over 20 Million US dollars used to promote industrial ventilation equipment, systems and services. Based on this, an European COST Action, G3 Industrial ventilation started to further promote this technology. The main aim of the action is to write the "bible" of Industrial Ventilation, DGB, Handbook of Industrial Ventilation. The first part of the book, fundamentals, comes out end of year. The publisher is Academic. Amount of participating writers is about 60, over 100 if we include reviewers. The writers are from 17 countries. This can be seen as a summary of recent research work worldwide in this technology area. This VENT 2000, international seminar in Industrial Ventilation in Finland gathers most of the writers to tell about this action. New writers are needed to participate to write the system and equipment book and applications. The book and the COST action include all the newest trends in this technology area.

Definition and Purpose of Industrial Air Technology

Industrial Air Technology (IAT) can be defined as:

Air flow technologies to control workplace indoor environment and emissions

A longer definition is:

1. **Air flow technologies to achieve and maintain a safe, healthy, productive and comfortable indoor environment in premises and occupied enclosures where this need is determined not only by human occupancy, normal human activities, and construction and finishing materials, but also and often primarily by other factors, for example production processes.**
2. **Process air technology such as air and gas purification, drying, or pneumatic conveying.**
3. **Safety air technology, including risk assessment, to minimize damages and hazards caused by accidents, fire and explosion**

The scope of industrial air technology includes premises other than traditional industrial process buildings, such as hospitals, underground car parks, mining, railroad and vehicle tunnels, livestock buildings, and other similar premises and processes.

Air Technology Systems

Industrial air technology system categories can be classified into three categories (industrial ventilation and process air technology and safety technology). A brief description of each type of the systems follows.

1. Industrial Ventilation

Air Conditioning Systems

Air conditioning systems include control of air quality and thermal environment for both human occupancy and processes.

General Ventilation Systems

In general ventilation system some indoor air parameters are controlled only partially. Target levels are usually lower than for air conditioning.

Local Ventilation Systems

Are used for local controlled zones. These systems are based on local capture of contaminants.

Process Ventilation Systems

In process ventilation the target is to maintain defined conditions to ensure process performance, e.g. paper machine hoods.

2. Process Air Technology

Cleaning Systems

Cleaning systems are used to remove contaminants, clean the resulting fluid flows and collect materials before discharging the exhaust air.

Pneumatic Conveying Systems

Conveying systems are used to transport captured pollutants from processes to a collection point.

Drying System

Drying systems are used to remove moisture, gases and vapours from the product

3. Safety Air Technology Systems

Structure of the DGB Book Fundamentals

1. Industrial Air Technology - Description

   Introductory chapter to the Design Guide Book. Describes the reasons why more attention should be paid on industrial air technology. Describes also the definition and purpose of industrial air technology, and the basic system principles.

2. Terminology

   Describes the set approach dealing with units, symbols and definitions, which are essential in providing texts which do not cause confusion by various chapters using different symbols relating to the same unit. Provides a common language throughout the book.

3. Design Methodology

   Design Methodology is the systematic description of the technical design process of industrial air technology, as an elementary part of the whole life cycle of the industrial plant.

4. Physical Fundamentals

   Introduces the important topics of fluid flow, properties of gases, heat and mass transfer and physical/chemical characteristics of contaminants. The aim is to assist all engaged in industrial air technology to understand the physical background of the issues involved.

5. Physiological and Toxicological Considerations

   The chapter introduces fundamentals of human physiology and health requirements relevant in the control of indoor environment within industrial buildings.

6. Target Levels

   The chapter presents a new concept called target levels. It outlines the role target levels in the systematic design methodology, scientific and technical grounds for assessing target levels for key parameters of industrial air technology, hierarchy of different target levels as well as some examples of quantitative targets.

7. Principles of Air and Contaminant Movement inside and around Buildings

   This chapter presents the basic processes of air and contaminant movement, such as jets, plumes and boundary flows.

8. Room Air Conditioning

   This chapter describes the room air conditioning process including interaction of different flow elements: room air distribution, heating and cooling methods, process sources and disturbances. Air handling equipment, including room air heaters etc. is discussed as "black boxes" as far as possible

9. Air Handling Processes

   Describes the fundamentals of air handling processes and equipment, and given answers to questions relating to the theoretical background of air handling unit and ductwork dimensioning and building energy systems optimization

10. Local Ventilation

Describes the aerodynamic principles, models and equations that govern the flow and the contaminant presence and transport in a designated volume of a work room. The purpose of Local ventilation is to control the transport of contaminants at or near the source of emission, thus minimizing the contaminants in the workplace air.

11. Modelling Techniques

The chapter describes calculation models for building energy demand and air flow in and around industrial buildings. Special attention is paid to simulation of airborne contaminant control.

12. Experimental Techniques

Experimental techniques cover a description of conventional measurement techniques used in ventilation, also other related topics like flow visualisation, laser based measurement techniques and scale model experiments.

13. Gas Cleaning Technology

Describes the fundamentals of gas cleaning technology in branches of removal of particulates and gaseous compounds. This chapter includes also the fundamentals of particulate and gaseous measurements technology.

14. Pneumatic Conveying

Basic principles of pneumatic conveying and equations are presented. A new pressure loss equation is presented with examples.

15. Environmental Life-cycle Assessment

Life cycle assessment, LCA is a compilation and evaluation of inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. The LCA methodology is comprehensively described based on the ISO 14000 series standards. References are also given to LCA information sources.

16. Economical Aspects

Life Cycle Cost (LCC) calculations are made to make sure that both the purchase price and the operating costs for life cycle are considered in investment decisions. In the chapter the basic calculation methods and sensitivity analysis are introduced. Examples of calculation results and references to LCC information sources are given.