

An aerial view of a city skyline featuring several prominent skyscrapers. The most prominent building on the left is a tall, cylindrical tower with a glass facade. Other buildings of varying heights and architectural styles are visible in the background. The sky is a clear, light blue.

ENERGY CONSERVATION AND IMPROVED IAQ WITH EXISTING VENTILATION STANDARDS

purafil
an SKF Group company

David Bennett, Arnold Edeling, Chris Muller, and Youssef Zougari
Purafil, Inc. - Doraville, Georgia USA

Introduction

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- Buildings have a significant impact on energy use and the environment.
 - Commercial and residential buildings use almost 40% of the primary energy and approximately 70% of the electricity in the United States.
 - Building sector energy use continues to increase.
 - Commercial building electricity consumption doubled between 1980 and 2000.
 - Expected to increase another 50% by 2025.
- Ventilation standards and mechanical codes have also evolved.
 - Building designers/engineers can address both IAQ and energy conservation.
- Air cleaning technologies have similarly developed.



ASHRAE Standard 62.1

- Since its first publication in 1973 to the current edition, ANSI/ASHRAE Standard 62.1-2013, *Ventilation for Acceptable Indoor Air Quality*, established methods to provide acceptable IAQ in buildings.
- It provided the prescriptive Ventilation Rate Procedure (VRP) approach to ventilation design by specifying the minimum outdoor air flow rates to achieve IAQ.
- It also offered the alternative IAQ Procedure (IAQP) for the use of innovative energy conservation practices.

Indoor Air Quality Procedure

- The IAQP provides an alternate, performance-based design approach.
 - Allows credit to be taken in the form of a reduction of the outside air intake rate(s).
 - The IAQP can also be used to attain specific target contaminant concentrations or levels of acceptability of perceived indoor air quality.
- Another consideration is the elevated pollution levels in many parts of the world makes increasing outdoor air ventilation rates undesirable.
- If one has to apply air cleaning for compliance with Standard 62.1, the use of the IAQP could pay for upgrades to the air cleaning system AND provide for a reduction in overall HVAC operating costs.

IAQP Examples

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- **Movie Theatre, New Construction, Single Zone Model**
 - Outdoor Air Amounts
 - VRP – 20 cfm/person (10 L/s)
 - IAQP – 5 cfm/person (2.4 L/s)
 - HVAC capital cost savings – 100 tons, US\$68,000.00 (€60,500)
 - HVAC operational cost savings – US\$15,000 (€13,300)/year

- **College Lecture Hall, New Construction, Single Zone Model**
 - Outdoor Air Amounts
 - VRP – 15 cfm/person (10 L/s)
 - IAQP – 5 cfm/person (2.4 L/s)
 - HVAC capital cost savings – US\$8,643.00 (€7,686)
 - HVAC operational cost savings – US\$1,136.00 (€1,010)/year

IAQP Examples (2)

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- **Retail Store, New Construction, Multizone Model**
 - Outdoor Air Amounts
 - VRP – 15 cfm/person (10 L/s)
 - IAQP – 7 cfm/person (2.4 L/s)
 - HVAC capital cost savings – US\$8,845.00 (€7,866)
 - HVAC operational cost savings – US\$2,641.00 (€2,348)/year

- **Office Building Renovation, Single Zone Model**
 - Outdoor Air Amounts
 - VRP – 15 cfm/person (10 L/s)
 - IAQP – 5 cfm/person (2.4 L/s)
 - HVAC capital cost savings – US\$300,000.00 (€266,800)
 - HVAC operational cost increase – US\$10,000 (€8,893)/year
 - Time to equalization – 28 years

The IAQP and Building Codes / Rating Systems

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- Standard 62.1-2013
 - Requires air cleaning for particulate matter (PM_{10} and $PM_{2.5}$).
 - Control of ozone is only required in limited areas.
 - Not required for other contaminants.
- Standard 189.1 (sustainability) saw ozone control as a critical requirement for compliance.
 - Efforts are currently being made to expand air cleaning requirements beyond ozone and particulate matter.
- In many locations ASHRAE Standard 62.1 is not the basis of HVAC system design.
 - Other design standards, codes, and building rating systems have to be considered.

International Mechanical Code (IMC)



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- Standard 62.1 can be used with the IMC for energy conservation.
- It is allowed under Section 105.2 on alternative materials, methods, equipment, and appliances.
 - *“The provisions of this code are not intended to prevent the installation of any material or to prohibit any method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material or method of construction shall be approved where... the proposed design is satisfactory and complies with the intent of the provisions of this code...”*
- The IMC does not preclude the use of the IAQP.
 - Many jurisdictions have modified local codes to show this as an approved ventilation system design approach.

USGBC Green Building Program



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- The U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design, or LEED, Green Building Rating System promotes a whole-building approach to sustainability.
- Indoor Environmental Quality (EQ), Prerequisite 1 is establishes the minimum performance to enhance IAQ in buildings, thus contributing to the comfort and well-being of the occupants.
 - Requires meeting the minimum requirements of Sections 4 through 7 of ASHRAE 62.1.
 - **Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure (VRP).**
 - The use of the IAQP is not allowed.

LEED and the IAQP?

It Can Be Done (and has been done)!

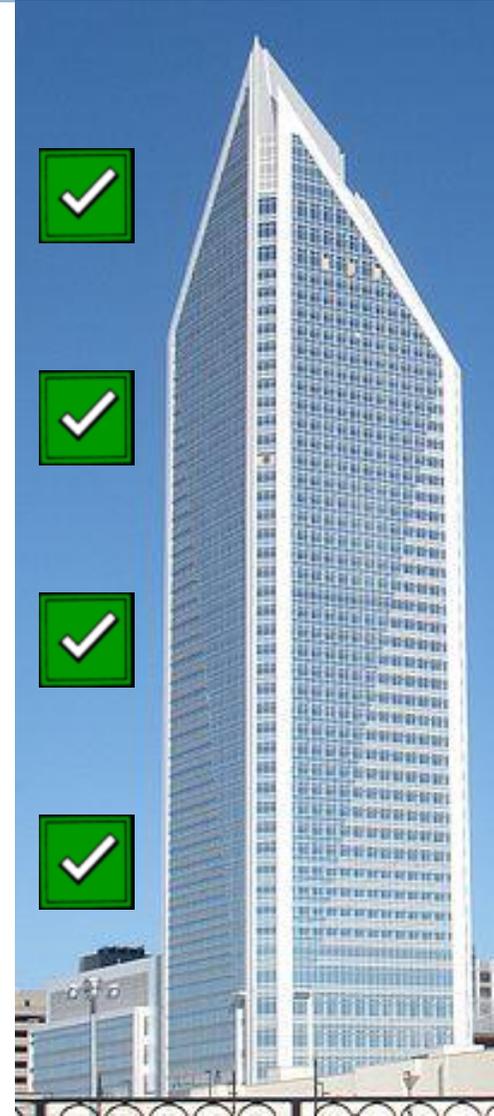
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Duke Energy Center, Charlotte, NC (USA)

- Owner ***demanded*** LEED certification **AND** to use the IAQ Procedure for energy savings and IAQ.
- LEED consultants said: 
- Owner said: “Find me a way!” 
- What did the consultant do?

Result: “Wells Fargo’s Duke Energy Center, in Charlotte, N.C., has earned the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) Platinum certification.”

(Environmental Leader, June 8, 2010).



The IAQ Procedure: Current Work

- The previous example showed that engineers realized that LEED only requires that the design of the ventilation system adhere to the VRP, but not its operation.
- Progress is being made to allow the use of the IAQP for LEED.
 - ▣ For the USGBC, this meant responding to the requests of design engineers, building owners and operators to formalize the process.
- ASHRAE Technical Resource Group (TRG 4.IAQP)
- USGBC IAQ Performance Testing Working Group
- LEED IAQP Pilot Credit

Summary & Conclusions

- Being able to achieve IAQ goals while reducing energy consumption is one of the more valuable aspects of using Standard 62.1.
 - ▣ Now being allowed for use on LEED projects under a pilot program developed by the USGBC.
- The use of enhanced particulate filtration and gas-phase air cleaning for contaminant control as an adjunct to or as a substitution for excessive ventilation has been an accepted practice since the energy concerns of the early 1970s.
- Since its introduction in the early 1980s, the IAQP has been an acceptable alternate method for attaining acceptable indoor air quality within established ventilation standards.

Summary & Conclusions

- Designing for compliance using the IAQP requires four steps:
 1. Identify contaminants of concern (COC) and emission rates;
 2. Determine acceptable concentrations of these contaminants;
 3. Specify the perceived indoor air quality criteria; and
 4. Apply mass balance analysis and subjective evaluation to achieve performance criteria.

- The IAQ Procedure is an often neglected a method for complying with ASHRAE Standard 62.1.
 - Practical applications of the IAQP have been presented.
 - Lowers HVAC-related energy consumption in buildings.

Thank you for your attention!



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Are there any questions?

Contact Information

Arnold Edeling

aedeling@purafil.com

+31 6 53 65 86 17

Chris Muller

cmuller@purafil.com

+1-404-578-1193