5th EDITION

JULY - SEPTEMBER 2024

कृषि एवं किसान कल्याण मंत्रालय
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
सत्यमेव जयते

National Centre for Cold-chain Development

COLD CHRONICLE

Everything about COLD-CHAIN

UNCONVENTIONAL COOLING

RAJASTHAN COLD CHAIN SUMMIT 2.0
PHDCCI

ISHRAE: COOL CONCLAVE 2024
Jaipur, Rajasthan

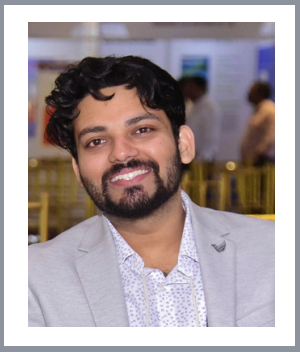
INDO-JAPAN JWG MEETINGS 2024
Bharat Mandapam, New Delhi

INSULATION: SPRAY PU FOAM
Article

RENEWABLE ENERGY SOURCE FOR COLD STORES
Article

CENTRE OF EXCELLENCE
Kartarpur, Punjab

EDITORIAL



EDITOR
PRITAM SARKAR
ENGINEER- NCCD

As the global focus shifts towards sustainability, the cold chain industry stands at the forefront of adopting renewable energy solutions to reduce operational costs and environmental impact. In this edition of Cold Chronicle, we delve into transformative developments that are shaping the future of the sector—solar-powered cold storage, international collaborations, and advanced insulation technologies.

The integration of solar energy into cold chain infrastructure is a game-changer, offering a cost-effective and sustainable alternative to conventional energy sources. Recognizing its potential, a team from NCCD recently visited Kartarpur to study a solar-based cold storage facility. This initiative underscores the feasibility of harnessing solar power to ensure uninterrupted cooling, even in remote locations. With rising energy prices and the urgent need to decarbonize, such solutions pave the way for a more resilient cold chain network.

With continuous innovation and collaboration, we can transform India's cold chain into a model of sustainability. We hope this edition of Cold Chronicle serves as an insightful resource for industry stakeholders, policymakers, and innovators working towards a more efficient and eco-friendly future.

You can share your views and ideas.
Mail to: *nccd.india@gmail.com*

CONTENTS

MESSAGE FROM DIRECTOR

SH. PRIYA RANJAN
JS- HORTICULTURE
DIRECTOR- NCCD

It is with great enthusiasm that we present this edition of Cold Chronicle, focusing on the transformative role of renewable energy in cold chain infrastructure. As sustainability becomes a key driver in the sector, the integration of solar-powered solutions and other green technologies is reshaping the way we store and transport perishable commodities.

In line with this vision, a team from NCCD recently visited Kartarpur to study a solar-based cold storage facility, an initiative that highlights the potential of renewable energy in reducing operational costs and carbon footprints. Such innovations align with India's sustainability goals and reinforce our commitment to decarbonizing the cold chain sector.

This edition brings you insightful perspectives, including expert opinions, case studies, and the latest advancements in green cold chain technologies. I extend my gratitude to all contributors for sharing their knowledge and experiences, which will surely inspire further adoption of sustainable practices.

MESSAGE FROM COO-NCCD

SH. ASHEESH FOTEDAR
COO - NCCD

In this edition of Cold Chronicle, we highlight key developments, including the recent Indo-Japan Joint Working Group Meeting, which focused on fostering collaboration in cold chain technology, energy efficiency, and policy frameworks. Strengthening international partnerships is crucial to integrating global best practices into India's cold chain ecosystem.

Additionally, we explore advancements in spray polyurethane foam (SPF) insulation, a highly effective technology for enhancing thermal efficiency and reducing energy consumption in cold storage and refrigerated transport. The use of SPF insulation is a step forward in achieving superior temperature control, lower operational costs, and a reduced carbon footprint.

I extend my sincere appreciation to all stakeholders and experts who continue to contribute to the evolution of India's cold chain sector. Your insights and innovations are driving us towards a more sustainable, energy-efficient, and future-ready cold chain network.

INDO-JAPAN JOINT WORKING GROUP MEETINGS ON AGRICULTURE AND FOOD PROCESSING

20th September 2024 **Bharat Mandapam, Delhi**

The Joint Working Groups (JWGs) of India and Japan convened for the 2nd meeting on Agriculture and the 3rd meeting on Food Processing on 20th September 2024 at Bharat Mandapam, Pragati Maidan, New Delhi. The discussions focused on strengthening bilateral cooperation, addressing policy challenges, and exploring opportunities for collaboration in agriculture, food processing, and cold chain logistics.

Opening Remarks by Indian Co-Chair (Food Processing JWG)

Mr. Minhaj Alam, Additional Secretary, Ministry of Food Processing Industries (MoFPI), emphasized the strengthening collaboration between India and Japan in agriculture and food processing. He highlighted the enduring partnership based on mutual trust and shared values, which extends beyond trade to economic growth, technology transfer, and cultural exchange.
India’s agri-food processing sector is undergoing rapid transformation, driven by initiatives such as PMKSY and PMFME, supported by 100% FDI and streamlined approvals. These reforms present significant opportunities for bilateral cooperation in cold chain infrastructure, technology transfer, and value addition.
Mr. Alam underscored India's growing agri-food exports to Japan, valued at USD 690 million in 2023-24, showcasing the potential for deeper engagement in fortified foods, organic products, and innovative packaging. He emphasized that this collaboration aims to address global challenges such as food security, waste reduction, and sustainable food systems, fostering a resilient and inclusive ecosystem for mutual growth.

Opening Remarks by Indian Co-Chair (Agriculture JWG)

Mr. Ajeet Kumar Sahu, Indian Co-Chair of the Agriculture JWG, welcomed the Japanese delegation and provided an overview of India-Japan cooperation in agriculture, outlining future collaboration prospects. He emphasized the mutual benefits of enhanced cooperation, particularly with India's rapidly growing agricultural startup ecosystem, offering significant investment opportunities for Japanese companies.
Addressing global sustainability concerns, Mr. Sahu highlighted India's focus on Climate-Resilient Agriculture and the government’s support for natural farming initiatives. Furthermore, with Japan's advanced fisheries technology and India’s emergence as a major fisheries exporter, he stressed the strong potential for collaboration in this sector.

Opening Remarks by Japanese Co-Chair

The Japanese Co-Chair expressed gratitude to the Indian delegation for their warm hospitality and efforts in organizing the JWG meeting. He reiterated that India and Japan are key leaders in the agriculture and food sectors, sharing a strategic global partnership.
He recalled the G7 Summit, where Indian Prime Minister Narendra Modi emphasized strengthening bilateral relations with Japan. Highlighting food security, environmental challenges, and sustainability as common priorities, he stated that both nations are committed to shaping the future frontier in agriculture through joint initiatives and cooperation.

Presentation by Mr. Asheesh Fotedar, COO, National Centre for Cold-Chain Development (NCCD)

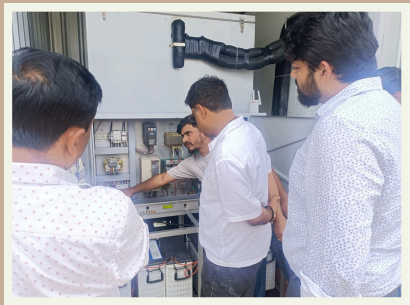
Mr. Asheesh Fotedar outlined NCCD's focus on five key principles—Technology, Modernization, Refrigerants, Climate, and Energy Efficiency—which form the foundation of India's evolving cold chain standards and guidelines set to be issued soon.

He highlighted India's ongoing efforts to modernize and develop the cold chain sector, proposing joint collaboration in:

- Adopting energy-efficient and climate-friendly technologies
- Mechanization of warehouses
- Utilizing smaller electric vehicles for last-mile cold chain logistics

These initiatives aim to enhance cold chain efficiency, reduce carbon footprints, and strengthen Indo-Japanese cooperation in agricultural logistics.

Centre of Excellence



Kartarpur, Punjab **23rd July, 2024**

The National Centre for Cold Chain Development (NCCD) recently conducted a technical visit to the Centre of Excellence for Vegetables in Kartarpur, Punjab. The visit, led by COO-NCCD Sh. Asheesh Fotedar and his team, provided an in-depth look at the cutting-edge solar-powered cold storage system designed to enhance perishable storage at the farm gate level.

One of the key highlights of the visit was the 10MT off-grid solar-powered cold storage system, comprising two chambers of 5MT each. The facility is designed to store perishable produce efficiently, ensuring minimal energy consumption through an innovative solar refrigeration system.

The system harnesses solar energy via PV arrays, using a DPPT algorithm to maximize extractable energy. The generated DC electricity is converted to AC through an inbuilt inverter, powering the refrigeration system

While the system presents a promising model for farm-level cold storage, NCCD proposed several recommendations to enhance safety, efficiency, and reliability

Future of Farm Gate Cold Storage

Beyond cold storage, the Centre of Excellence is a self-sustaining unit, leveraging solar technology for electricity and funding operations through the sale of harvested vegetables. The facility also houses an image-processing-based grading and packing line, ensuring a streamlined post-harvest value chain.

The Kartarpur facility serves as a beacon of innovation, demonstrating the feasibility of solar-powered cold storage in agricultural supply chains. With minor enhancements, this model can be replicated nationwide, supporting farmers in reducing post-harvest losses and ensuring a more resilient cold chain infrastructure.

As India continues its journey towards sustainable and energy-efficient agricultural solutions, such technological advancements will play a crucial role in achieving a robust, climate-resilient supply chain. The NCCD remains committed to supporting and promoting such initiatives for a greener and more efficient future in the cold chain sector.

Discussion on Growth and Development

Following the visit, NCCD engaged in discussions with the officials at the Centre of Excellence regarding the growth and development of the cold chain sector in the region. The conversation focused on expanding cold storage infrastructure, integrating advanced technologies, and improving logistics to enhance the efficiency of perishable storage and distribution.

COOL

CONSULTANTS, OWNERS & LEADERS

CONCLAVE

1st-3rd Aug 2024 **Jaipur, Rajasthan**

The ISHRAE Cool Conclave 2024, a three-day event focused on sustainability in the HVAC&R industry, commenced on Thursday in Jaipur, Rajasthan's capital. The conclave, held at the Jaipur Exhibition and Convention Centre, provided a platform for industry leaders, policymakers, innovators, and environmentalists to discuss actionable strategies for reducing carbon emissions and promoting sustainable practices.

Inaugural Address: A Call for Environmental Awareness

The event was inaugurated with a keynote address by Dr. Lakshyaraj Singh Mewar, a member of the former royal family of Udaipur. He emphasized the need to enhance children's understanding of environmental sustainability and heritage, urging parents and educational institutions to play an active role in this effort. He stated that the conversation around sustainability and heritage will only be meaningful if future generations are made aware of their importance. Mr. Dharkar, another esteemed speaker, highlighted the urgent need to accelerate efforts to combat climate change.

On the second day, discussions took a deep dive into decarbonization, exploring innovative solutions and strategies. Participants engaged in dialogues aimed at gaining valuable insights, identifying cutting-edge solutions, and shaping policies for a sustainable and resilient future. Sh. Pankaj, Chairman of the Cool Conclave, stated that the ongoing event is proving to be an excellent opportunity for professionals and organizations dedicated to environmental sustainability.

NCCD's Presence: Advancing Sustainable Cold Chain Solutions

Mr. Asheesh Fotedar, Chief Operating Officer (COO) of NCCD, moderated Track 5, held in Hall 2, which focused on "Energy-efficient and Planet-friendly Cold Chain Infrastructure." This session, titled "Chilling Choices: Exploring Sustainable Solutions for Energy-Efficient and Eco-Friendly Cold Chain Infrastructure," brought together leading experts from the industry, research institutions, and policy-making bodies.

The discussion addressed key challenges and opportunities in decarbonizing cold storage, reducing energy consumption, and implementing cutting-edge refrigeration technologies. The session also examined innovative cooling solutions, including:

- Energy-efficient refrigeration systems that minimize greenhouse gas emissions
- Renewable energy integration in cold storage facilities
- Advanced insulation techniques to improve thermal efficiency
- Policy and financial mechanisms to drive sustainable investments in the sector

The ISHRAE Cool Conclave continues to serve as a pivotal forum for industry stakeholders, driving meaningful discussions and initiating impactful actions towards a low-carbon future in the HVAC&R sector.

Energy Efficiency

The Role of Energy Efficiency in the Cold Chain Sector and the Need for a Dedicated Datasheet

The cold chain sector plays a crucial role in ensuring the quality, safety, and longevity of perishable goods, including food and pharmaceuticals. However, it is also an energy-intensive industry, with refrigeration, transportation, and storage operations consuming substantial amounts of electricity and fuel. With India's growing commitment to sustainability and net zero emissions, improving energy efficiency in cold chain operations is imperative. Recognizing this need, the National Centre for Cold Chain Development (NCCD) has revised its guidelines and technical standards for 2025, introducing a dedicated datasheet for Energy Efficiency. This article explores the necessity of this datasheet, its intended purpose, and the potential outcomes it aims to achieve.

The Need for an Energy Efficiency Datasheet

1. **Monitoring and Benchmarking Energy Consumption:** Cold chain facilities operate with diverse energy demands, influenced by factors such as climate conditions, storage capacity, and technology used. The inclusion of an energy efficiency datasheet enables facility managers and policymakers to track and benchmark energy consumption across different units, facilitating the identification of inefficiencies.
2. **Compliance with Sustainability Goals:** India's pledge towards reducing carbon emissions and achieving net zero by 2070 necessitates stringent measures to cut down energy wastage. The datasheet will help ensure compliance with energy efficiency regulations and sustainability commitments, assisting businesses in aligning their operations with national and global environmental standards.
3. **Optimizing Energy Utilization:** By maintaining detailed records of energy consumption, businesses can analyze patterns and identify areas where energy-saving measures can be implemented. This includes optimizing refrigeration systems, reducing load wastage, and improving insulation techniques.
4. **Cost Reduction and Operational Efficiency:** Energy costs constitute a significant portion of operational expenses in the cold chain sector. The datasheet will enable businesses to track energy expenditure, allowing them to implement cost-effective solutions such as demand-side management, automation, and renewable energy integration.

The introduction of a dedicated Energy Efficiency datasheet by the NCCD in its revised 2025 guidelines is a significant step towards enhancing sustainability in the cold chain sector. By systematically recording and analyzing energy consumption, this initiative will drive operational efficiency, cost savings, and environmental benefits. As India progresses towards its net zero commitments, energy-efficient practices in the cold chain industry will play a pivotal role in achieving long-term sustainability goals.

Ripening Chambers

Transforming the Fresh Produce Industry

Ripening chambers have revolutionized the way fruits are prepared for market, ensuring consistent quality and extending shelf life. These specialized units are crucial for ripening climacteric fruits like bananas, mangoes, and avocados in a controlled manner, reducing post-harvest losses and meeting consumer demands for freshness.

The Science Behind Ripening Chambers

Ripening chambers work by regulating three primary factors:

1. Ethylene Gas: A natural plant hormone that accelerates ripening.
2. Temperature: Maintained between 14°C to 18°C to prevent premature decay.
3. Humidity: Kept at 85%-95% to retain moisture and prevent shrinkage.

Proper ventilation ensures uniform ripening by dispersing ethylene gas evenly while removing excess carbon dioxide.

Advantages of Using Ripening Chambers

- Consistent Quality: Fruits ripen uniformly, improving appearance and taste.
- Extended Shelf Life: Reduces spoilage and ensures longer freshness.
- Sustainability: Modern chambers use energy-efficient methods, lowering operational costs.
- Market Readiness: Fruits can be ripened on demand, reducing wastage.

Challenges in Ripening Chamber Operations

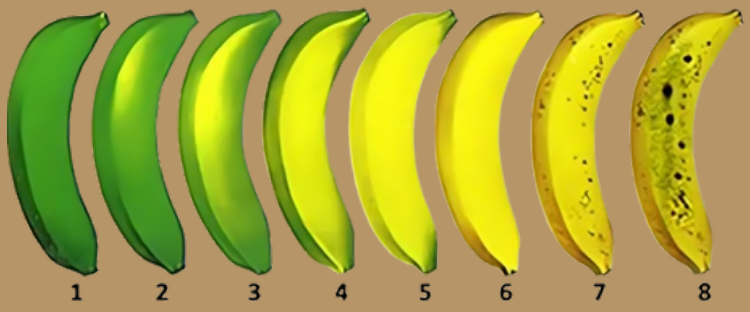
Despite their benefits, ripening chambers face challenges such as:

- Energy Consumption: High power usage can increase operational costs.
- Ethylene Mismanagement: Excess exposure can lead to overripening.
- Regulatory Compliance: Strict food safety standards must be met.

Future Trends in Ripening Technology

With advancements in automation, AI-driven monitoring, and IoT-enabled sensors, the future of ripening chambers is focused on efficiency and sustainability. These innovations will help optimize conditions, reduce energy waste, and improve overall productivity in the cold chain industry.

Ripening chambers are an indispensable asset in the fresh produce supply chain, helping businesses deliver high-quality fruit while minimizing losses and maximizing profits.



Ripening Chart of BANANA

Written by-
Sh. Devansh Raghuvanshi
NCCD

Powering Cold Storages Unconventionally

Cold storages play a crucial role in our food supply chain, ensuring the freshness and safety of perishable goods. However, traditional cold storage facilities often rely heavily on fossil fuels, contributing significantly to greenhouse gas emissions. To address this challenge, renewable energy sources are increasingly being integrated into cold storage operations, paving the way for a more sustainable and eco-friendly future.

Key Renewable Energy Sources for Cold Storages

1. Solar Power:
   - Photovoltaic (PV) Panels: Solar panels convert sunlight directly into electricity, which can power refrigeration units, lighting, and other equipment within the cold storage facility.
   - Solar panels on the roof of a cold storage facility

2. Wind Power:
   - Wind Turbines: In areas with consistent wind resources, wind turbines can generate electricity to power the refrigeration systems and other energy-intensive operations.
   - Wind turbines near a cold storage facility

3. Geothermal Energy:
   - Ground Source Heat Pumps: Geothermal systems utilize the stable temperature of the earth to heat and cool the cold storage facility. In colder climates, geothermal energy can be used directly for refrigeration.
   - Geothermal heat pump system for a cold storage facility

4. Biomass Energy:
   - Biogas Digesters: Organic waste generated from agricultural activities can be converted into biogas, a renewable fuel that can be used to power generators for the cold storage facility.
   - Biogas digester near a cold storage facility

Benefits of Using Renewable Energy in Cold Storages

Reduced Carbon Footprint: By utilizing renewable energy sources, cold storage facilities can significantly reduce their greenhouse gas emissions, contributing to a cleaner and healthier environment.

Cost Savings: Renewable energy systems can help reduce operating costs in the long term, as they eliminate the need to rely on expensive grid electricity.

Energy Independence: By generating their own power, cold storage facilities can reduce their dependence on the grid, ensuring a more reliable and consistent energy supply.

Improved Brand Image: Adopting renewable energy practices can enhance the brand image of cold storage operators, appealing to environmentally conscious consumers.

Challenges and Considerations

Initial Investment: The initial investment in renewable energy systems can be substantial.
Intermittency: Some renewable energy sources, such as solar and wind power, are intermittent, requiring energy storage solutions or backup systems to ensure a continuous power supply.

Technical Expertise: Proper design, installation, and maintenance of renewable energy systems require specialized technical expertise.

The Future of Cold Storage and Renewable Energy

As technology continues to advance and the cost of renewable energy systems decreases, their integration into cold storage facilities is expected to become more widespread. By embracing sustainable practices, the cold storage industry can play a vital role in reducing its environmental impact and ensuring a more sustainable food supply chain for future generations.

DID YOU KNOW?

Solar energy is almost 200 years old

Hydropower is the world's largest source of renewable energy

Romans were the first to use geothermal energy to heat their homes

Wind turbines have around 8,000 parts

2ND RAJASTHAN COLD CHAIN SUMMIT

The National Centre for Cold Chain Development (NCCD), in collaboration with the PHD Chamber of Commerce and Industry, successfully organized the 2nd Rajasthan Cold Chain Summit on 12th July 2024 at the Hilton Hotel, Jaipur. As the knowledge partner, NCCD played a crucial role in shaping the discussions and highlighting key industry challenges and solutions.

THEME: "EMPOWERING COLD CHAIN WITH SUSTAINABLE PRACTICES & NET ZERO SOLUTIONS"

12TH JULY — JAIPUR, RAJASTHAN

The summit focused on advancing sustainable practices and achieving net-zero solutions in the cold chain sector. It provided a platform for industry leaders, policymakers, and experts to deliberate on the future of cold chain development and strategies for a more resilient infrastructure.

SH. VAIBHAV GALRIYA

IAS, Principal Secretary, Agriculture & Horticulture Dept. Govt. of Rajasthan

Distinguished Presence

The event was honored by the esteemed presence of Sh. Vaibhav Galriya, IAS, Principal Secretary of the Agriculture & Horticulture Department, Government of Rajasthan, who attended as the Chief Guest. His participation added immense value to the summit, as he shared profound insights on the current challenges and opportunities in the agriculture and horticulture sectors. His address emphasized the importance of policy-driven initiatives, technological advancements, and sustainable practices in strengthening the cold chain and allied industries.

Moreover, his unwavering support and commitment to fostering innovation and infrastructure development significantly contributed to the success and impact of the summit. His encouraging words and strategic vision resonated with industry stakeholders, reinforcing the collective efforts toward a more resilient and efficient cold chain ecosystem.

Stakeholder Participation

The summit saw active participation from key stakeholders, including industry leaders, government officials, dairy and fisheries representatives, retailers, distributors, environmental experts, and logistics professionals. The diversity of participants ensured comprehensive discussions on challenges and opportunities within the cold chain sector.

Key Highlights

- **NCCD Initiatives:** The summit showcased ongoing initiatives led by NCCD, emphasizing the urgent need for a well-integrated cold chain network.
- **Sustainability & Net Zero Solutions:** Experts discussed innovative approaches and technologies to enhance efficiency while reducing environmental impact.
- **Industry Collaboration:** The event fostered dialogue among stakeholders, promoting partnerships to drive forward sustainable cold chain solutions.
- **Key Discussion Topics:** Sessions focused on solar-powered cold storage solutions, advancements in refrigeration technology, IoT and AI in cold chain management, and blockchain for traceability.
- **Networking & Knowledge Sharing:** The summit provided an excellent opportunity for stakeholders to connect, exchange ideas, and explore collaborations for a sustainable future.

Acknowledgment

NCCD extends heartfelt gratitude to all participants, speakers, and partners who contributed to making this summit a grand success. Their collective efforts are paving the way for a sustainable and robust cold chain infrastructure in Rajasthan and beyond.

With such continued collaboration, the cold chain industry is set to embrace a future of efficiency, sustainability, and innovation. The vision of achieving a carbon-neutral cold chain sector is now closer to reality, thanks to the proactive initiatives and shared commitment demonstrated during this summit.

Spray Polyurethane Foam as Cold Store Envelope

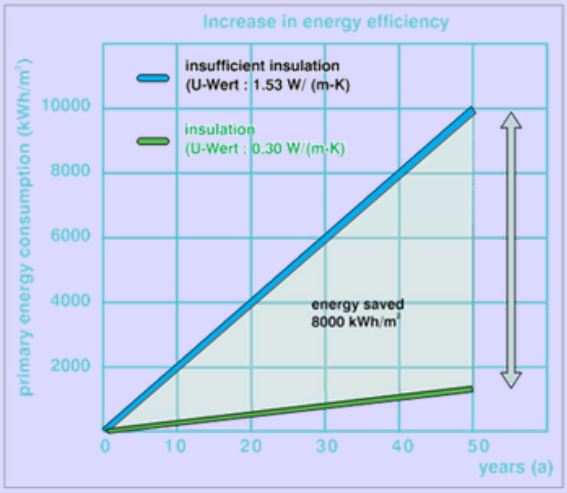
India is seeing dramatic increases in domestic energy consumption. Ongoing industrialization, which includes the proliferation of warehouses and cold stores, and continuing development have already caused energy and peak demand shortages at an average of around 8% and 12% respectively over recent decades.

Buildings are responsible for around 30 percent of global energy use and greenhouse gas emissions, according to the Sustainable Buildings and Climate Initiative of the United Nations Environment Program (UNEP SBCI). The challenges with respect to climate-friendly design are expected to grow in the future. For example, rising temperatures increase the demand for energy-intensive air conditioning systems. Therefore, energy saving buildings of the future can make an even bigger contribution to climate protection than today.
The building sector today already offers a sufficient number of market-ready solutions to support a green cold stores. These solutions can reduce the primary energy requirement by significant levels in cold stores. Standard solutions of the one size fits all variety are inadequate for achieving savings of this size, because in order to build environment-friendly buildings, it is critical to incorporate local climate conditions into the design from the outset. Retrofitted climate control systems would only drive up costs unnecessarily. To minimize the energy requirements of a building, its shape and envelope must be optimized and the building systems designed for maximum efficiency. The right insulation material plays an important role in achieving energy efficiency; much could be achieved if thermal insulation in general were given sufficient consideration from the start, in the planning phase. Studies show that buildings insulated with sprayed polyurethane foam typically use 30 percent less energy for heating and cooling compared to buildings insulated with traditional fibrous insulation material.

Architecture and Energy Savings

The building envelope is our “third skin” (after skin and clothing) where we spend 90% of our daily time. The design and material used in buildings have a direct effect on healthy living. Poor ventilation and high heat transfer coefficient of building materials can lead to condensation and structural damage. Sustainable construction as an all-in solution is a novel idea in the construction industry. Architects and designers usually face technical challenges in the following areas:
•Compact design: surface area to volume ratio.
•Energy-efficient construction: minimizing the U-values, avoiding thermal bridges.
•Excellent thermal insulation in the external components: high insulating efficiency per unit area.
•Wind-tight and air-tight building shell.
•Mechanical ventilation (heat recovery in some cases): limiting the relative humidity.
•Rapidly controllable heat/ cold distribution: adaptability.

The architectural challenge comprises of synthesis of technically perfect construction, correct use of materials, sensible utilization and efficient project planning. Effectively, it boils down to giving the design processes a specific direction governed by external factors like conservation of resources, climate protection, energy efficiency and developing a new aesthetic. With the new role play of architects as stylists and engineers, their responsibilities widen to
•Create appropriate architectural designs from it, not simply “form follows U-value”.
•Author new developments, e.g. in the styling of façades of large, complex buildings.
•Design an energy system, a power station, a living system
•that can respond to changes in the environment.
•Turn the technical requirement to a style challenge.



Energy efficiency in architecture would be inconceivable without the use of insulating materials. Optimum energy efficiency can be achieved with high-performance insulating materials such as polyurethane rigid foam. Life Cycle Assessments (LCA) performed on insulation products have demonstrated that energy savings during the use phase far outweigh energy associated with manufacturing the raw material, formulating components, transporting, installing and managing at end- of-life. LCA for some individual chemical product applications, including insulation, were calculated in the ICCA report. The life cycle assessment is a recognized multi-step, well-structured methodology that performs environmental impact analysis (based on ISO 14044:2006). LCA assess energy and environmental impacts of a material in a specified application from cradle to end-of-life.

LCA results support decision-making on new projects and compare the energy and environmental impact of different products with quantitative data factoring in all the life cycle phases. LCA calculations show that the highest values obtained with an increase of insulation can contribute substantially to energy efficiency improvement. It contributes to fossil fuel conservation and greenhouse gas reduction. A building and its shell constitute a system with a long life and a correspondingly long-term energy-saving effect.

Less is More

Insulation takes space. How much depends on the insulating performance of the material used. Rigid foams made of polyurethane insulate better than any other commercially available insulating material. This saves space, provides for thin solutions and even allows for more living space. Insulation effectiveness is a function of the type and thickness of the material used to make it. In this context, the lower the thermal conductivity (λ) of the material, the better its insulating performance.

Against this backdrop, rigid polyurethane foam possesses a unique advantage. Of all the commercially available insulating materials, it exhibits the lowest value at 0.018 watt per meter per degree Kelvin4. Other insulating materials, such as polystyrene, rock wool, glass wool or hemp fibers, display significantly higher thermal conductivity values.

Insulating materials are important in the first place because standard building materials, such as concrete, brick and wood, conduct heat relatively well. By comparison, the thermal conductivity of concrete(λ=2.1) is nearly90 times higher than that of polyurethane. As a result, even a relatively thin layer of polyurethane one centimeter thick insulates just as well as a concrete wall 90 centimeters thick.

For example, 21 centimeters of polyurethane insulates just as effectively as 28 centimeters of expanded polystyrene or 32 centimeters of mineral wool.

This difference can be of great significance. In the case of new buildings, for instance, walls can be of a thinner design overall when using polyurethane. This ultimately means increased interior space, i.e. more living space. In the same example, the gain with polyurethane for every exterior wall requiring insulation is equivalent to seven centimeters compared with polystyrene and as much as eleven centimeters compared with mineral wool. The same applies for floor, ceiling and roof insulation. In these areas, the use of polyurethane enables the best-possible ceiling height for a given level of insulating performance. Similar advantages exist when subsequently insulating an existing building.

It is often impossible to install layers of insulation on the exterior, either for reasons of space or because it is a landmark building. Interior insulation, on the other hand, inevitably means a loss of living space. As described above, this loss can be minimized by using polyurethane. Even if it is possible to install exterior insulation, the thinner solution with polyurethane still offers the most advantages. However, the use of external spray foam insulation has the added advantage of extending the building life as its minimal thermal mass allows little expansion and contraction due to heat and cold cycles. On the other hand, the solid walls and roofs expand and contract significantly thus resulting in cracks and eventual loss of water proofing and consequent seepage, limiting the building life.

The PUF Advantage

Rigid polyurethane foam is suitable for extended use at temperatures of -30 to+120°C. Even contact with the chemical substances typically found in construction, such as adhesives, wood preservatives or bitumen, does not affect polyurethane. The material does not rot, resists mold and is odor-neutral.

Figure 3: Space saving with different insulationmaterials

Because rigid polyurethane foam has a closed-cell structure, it does not absorb moisture from the air or exhibit capillary activity. This means the usual building dampness does not penetrate the material if installed properly – an important aspect, because otherwise the insulating properties would deteriorate.

The closed-cell structure also ensures that the gas contained in the pores cannot escape. Special facings on rigid PU foams further prevent air from penetrating the material. Both aspects are decisive for maintaining good insulating properties over an extended period of time.

PU and PIR comply with the fire standards

As an organic material, polyurethane is flammable. However, flammability in itself is not the problem. After all, other building materials, such as wood, also burn. What is important is that by adding flame retardants, rigid polyurethane foams can be produced that are classed as having low to normal flammability. They can be used as thermal insulation in virtually every application in the building industry. Classifications of this kind are based on standardized tests.
So an eventual fire cannot spread undetected through an insulation layer. Similarly, the reigniting of a previously extinguished fire is observed just as rarely. Another important aspect in practice is that rigid PU foam does not melt or form flaming droplets in a fire. This distinguishes PU from polystyrene, which softens even at comparatively low temperatures, melts and the flaming droplets can even spread a fire.
A lot of progress has been made in recent years in the field of flame protection for rigid PU foams. For example, new PU formulations with an excess of isocyanate have been developed, known as polyisocyanurate (PIR). The resulting foams are inherently more resistant to heat. They require only one-third the amount of flame retardant contained in older rigid foams.

Conclusion

Over the years, polyurethane foam has emerged as the insulation of choice for building envelopes due to its low conductivity, good gas and vapour barrier properties, low flammability, self-adhesion, chemical stability, construction efficiency and ease of application compared to other insulation materials.
For more details, please visit www.indiainsulationforum.in and https://sfaindia.net/

Author: Mr. Isaac Emmanuel

Emmanuel is a post graduate in polymer chemistry from Madras University and has spent the past three decades in the field of engineering polymers industry in India. Having worked extensively with the automotive, sports, industrial, mechanical and railway segments as well as in the construction and Cold Chain segments, besides solar, wind and wood binder markets. He works closely with industry bodies for the cause of sustainability.After 32 years of varied experience with Covestro / Bayer MaterialScience, he now serves as Professor of Practice at Somaiya Vidyavihar University as well as Independent Consultant on promoting sustainable technologies.

कृषि एवं किसान कल्याण मंत्रालय
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
सत्यमेव जयते

Address: Plot No. 85, Sector-18, Institutional Area,
Gurugram -122015
Contact: +91-124-2979650
Website: https://www.nccd.gov.in

NCCD
National Centre for Cold-chain Development

https://twitter.com/NCCDIndia

https://www.linkedin.com/in/nccd-india/