Daikin Presentation
Understanding A2L Refrigerants for Air Conditioners

Daikin U.S. Corporation
November 12th, 2019
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Summary of the Presentation
Introduction of Daikin
Daikin’s Global Presence

- **Company:** Daikin Industries, Ltd.
- **Head Office:** Osaka, Japan
- **Founded in:** 1924
- **Chairman of the Board:** Noriyuki Inoue
- **President and CEO:** Masanori Togawa
- **Employees:** 70,263
- **Group Companies:** 245

**FY2018 Net Sales:** $21.3B

- **Air Conditioning:** 89.8%
- **Fluorochemicals:** 8.0%
- **Others:** 2.2%

**Air Conditioning**

Global No.1

**Fluorochemicals**

Global No.2

**Air Filtration and Oil Hydraulics**
Global Expansion

Changes from 2005 to present

- Business Expansion: 63 ⇒ 150+ countries
- Production Bases: 23 ⇒ 90+ bases
- Overseas Business Ratio: 46 ⇒ 75%

Sales bases
Production bases
Production and R&D Bases in the U.S.
Daikin’s Air Conditioning and Heating Products
Daikin’s Refrigerant Policy
Daikin’s Refrigerant Policy: Diversity of Refrigerants

The main tenet of Daikin’s policy is “diversity of refrigerants” and reducing impacts through a “life cycle approach”.

To reduce the environmental impact of a refrigerant throughout its lifecycle, we evaluate various aspects comprehensively to select the appropriate refrigerant for each application.
In September 2019, Daikin business units in North America announced they will develop ducted and ductless residential, light-commercial, and applied products using R-32. Daikin has found that in comparison to R-410A, R-32 has a drastically lower GWP and could reduce refrigerant charge in certain equipment by up to 40 percent. The company believes that R-32—a pure, single component refrigerant available globally from multiple suppliers—is easier to reuse, reclaim, and recycle when compared to other refrigerants that are blends of R-32 and other components.

To advance the adoption of R-32, Daikin has committed to share its knowledge and expertise. In 2019, Daikin announced its patent non-assertion pledge of identified patents to further facilitate the use of the R-32 in HVAC products.
Challenges in North America
Updated standards and codes are being written, but it is a lengthy and difficult process.

There is a patchwork of building code adoption
- IMC Adoption Statewide
- IMC Adoption by Jurisdiction, All Adopted IMC
- UMC Adoption Statewide
- UMC Adoption by Jurisdiction, All Adopted UMC
- Mixed Adoption (IMC, UMC, IFGC, IBC, UPC, etc.)

Efforts to make changes to building codes have faced much opposition and resistance due to a lack of knowledge and misinformation.
Examples of misinformation - Flammability

Myths about flammability of A2L refrigerants

Group A2L refrigerants burn very easily and can explode when there is a risk.

A1 refrigerants are noncombustible or non flammable refrigerants

A2L refrigerants give off harmful chemicals when they burn while A1 refrigerants don’t

A2L refrigerants are dangerous during a wildfire.
Examples of misinformation - Standards

Myths about A2L standards

- The standard for testing and listing A2L equipment is not complete.
- The A2L refrigerant requirements were rushed through ASHRAE 15.
- ASHRAE 15 will allow hundreds of pounds of A2L refrigerant to be located in a residence.
Examples of misinformation – Others

Phase down schedule, Lack of research and training etc.

- A2L refrigerants are just a phase; newer refrigerants will be A1 refrigerants and the industry just need to wait.
- California will ban the use of R410A for ALL installations and servicing in 2023.
- Additional research is necessary on A2L refrigerants before they are used.
- Contractors are not receiving adequate training regarding the use of A2L refrigerants.
- A2L refrigerants require special installation tools.
Countermeasure for misinformation about A2L refrigerants
Daikin published a sponsored article on the ACHR News to educate readers (contractors) by addressing their concerns about A2L refrigerants.

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The current round of changes aims to reduce the greenhouse effect of refrigerants, as those atmospheric measurement have also confirmed the steady increase of greenhouse gases over the last several decades, some of which are synthesized substances with no naturally occurring sources.
The Kigali Agreement

- The most recent revision of the Montreal Protocol
- Created in October 2016, became effective globally on Jan. 1, 2019.
- It has been ratified by 88 countries as of this October
- The Kigali Amendment added restrictions to the Montreal Protocol on substances with global warming potential (GWP), which will result in a phasedown of refrigerants with higher GWP and a transition to lower-GWP refrigerants.
- The goal is to reduce usage of existing refrigerants to just 15% of the baseline by 2037.

Position of the U.S.

- The U.S. has no ratified the Kigali Amendments.
- No federal policy or regulation exists at this time to reduce higher GWP refrigerants.

State Level

- Some states are moving ahead in the absence of nationwide action.
- California is leading the activity. Proposed is a limit of GWP<750 for refrigerant in new air conditioners effective Jan. 1. 2023.
To shift the balance towards being more environmentally friendly, we must accept some degree of flammability.

Refrigerant molecules with reduced number of fluorine atoms generally have lower GWP, but these refrigerants have a higher proportion of hydrogen atoms.

**New Category: A2L**

Transitioning to low-GWP refrigerants doesn’t mean compromising on safety. The leading lower-GWP candidates fall into the relatively new lower flammability classification of A2L.

<table>
<thead>
<tr>
<th>Safety Group Classification</th>
<th>A3</th>
<th>A2</th>
<th>A2L</th>
<th>B2L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance</td>
<td>Propane</td>
<td>1,1 Difluoroethane</td>
<td>Difluoromethane</td>
<td>Ammonia</td>
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<tr>
<td>Refrigerant Designation</td>
<td>R 290</td>
<td>R 152a</td>
<td>R 32</td>
<td>R 717</td>
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<tr>
<td>Chemical Formula</td>
<td>C₃H₈</td>
<td>C₂H₄F₂</td>
<td>CH₂F₂</td>
<td>NH₃</td>
</tr>
<tr>
<td>Burning Velocity (m/s)</td>
<td>0.39</td>
<td>0.23</td>
<td>0.067</td>
<td>0.072</td>
</tr>
<tr>
<td>Heat Of Combustion (MJ/kg)</td>
<td>46</td>
<td>16</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Combustion Image</td>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
<td><img src="image3.png" alt="Image 3" /></td>
<td><img src="image4.png" alt="Image 4" /></td>
</tr>
</tbody>
</table>

**Toxicity: A, B**  
**Flammability: 1, 2, 2L, 3**

Class 2L refrigerants have lower probability of ignition as well as lower severity of ignition events, significantly reducing the flammability risk relative to Class 2 or 3.

\[ \text{FIGURE 2: Representation of ASHRAE Standard 34 refrigerant flammability classification.} \]
To shift the balance towards being more environmentally friendly, we must accept some degree of flammability.
More than 68 million air conditioners using A2L refrigerants have been installed around the world.

Majority of units have been installed in Asian and European countries such as Japan, China, India, Italy, France, Germany, and Australia.

To date, no accidents or incidents have been reported.

The US is lagging behind the rest of the world due to its slow progress in making changes to building codes and product safety standards.
The overall risk

Probability of Occurrence × Severity of the Event

Approaches to mitigate risks

Avoid the release of refrigerant

Restrict the maximum allowable quantity of refrigerant

Research on how to safely use A2L refrigerants

- AHRI, ASHRAE and US DOE have collaborated to publish numerous reports
- Focal area has been refrigerant charge quantity limits. They are based on:
  - The available space to which released refrigerant can disperse
  - The elevation from which refrigerant could be released
  - Presence of a fan in the equipment for recirculation air movement
  - Presence of ventilation system to supply and exhaust air in the space
Purpose of Air Recirculation & Mechanical ventilation

Mix and dilute the released refrigerant to keep the average concentration below 25% of the LFL
There is a need to communicate and educate stakeholders:

- **Installers and service technicians** will be trained on the new requirements through several programs to be offered by air conditioners manufacturers and other associations such as NATE and ACCA.

- Installers must follow the manufacturer’s instructions:
  - Confirmation that the room size is adequate

- Fire officials need to know when periodic inspection of refrigerant sensors is required.
Cooling and heating are an essential part of life, and due to environmental impact, existing A1 refrigerants will transition to A2L refrigerants in ACs and HPs.

It is in the best interest of all stakeholders to understand how to safely work with A2L refrigerant as they are adopted into use.

While there are some new considerations with A2L refrigerants, the changes are incremental in nature.
Daikin is constantly mindful of the environmental and climate change impact of our products.

Daikin adopted R-32 for key products in North America.

In the US, efforts to make changes to building codes have faced opposition due to a lack of knowledge and misinformation.

To educate stakeholders, Daikin published an article to address their concerns on A2L refrigerants.

Daikin will continue to promote A2L refrigerants to mitigate global warming.
Thank you!!
Questions?