Aerosol Sealing: From Lab to Market to University to Market Again

Mark Modera
Professor, UC Davis
Western Cooling Efficiency Center Director, UC Davis
Lead Scientist, Aeroseal

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Presentation Overview

• Brief History of Aerosol Sealing
• Evolution of duct sealing TECHNOLOGY
• Turning a TECHNOLOGY into a BUSINESS
• Adding new applications/markets
• New TECHNOLOGY development – Envelope Sealing
• Q&A
Brief History of the World of Aerosol Sealing

1979: Discovery that duct leakage is important
1987: First conception of aerosol sealing for ducts
1991: Sacramento field study shows 18% savings from duct sealing
1994: Laboratory proof of concept for aerosol duct sealing at LBNL
1996: Popular Science and DOE awards for aerosol duct sealing
1997: AEROSEAL founded
1999: First HVAC contractors selling AEROSEAL
2001: AEROSEAL purchased by Carrier
2006: Gen-2 AEROSEAL equipment released
2010: AEROSEAL spun out from Carrier
2011: First envelope sealing at UC Davis
2015: Aerosol Envelope sealing licensed to Aeroseal by UC Davis
2016: 10X Revenue growth since Carrier divestiture
Snapshot of Sealing (1994)

2-D Slot

Particle Build-up

Duct Wall
First Aerosol Duct Sealer

1994: First Field Test
Second Aerosol Duct Sealer

1995-1997: Used for BETA Testing in Houses
From the Lab to Market

STEP 1: Many steps taken at LBNL to prepare for commercialization
  • Safety, practicality, sealant longevity, performance, value

STEP 2: Nobody wanted to license the technology
  • No existing market
  • Revolutionary vs. Evolutionary technology

STEP 3: Licensee with strong motivation
  • Make or break motivation
  • Need someone to drink the Kool-Aid
  • I turned out to be the best (potentially only) candidate

STEP 4: A wild ride
  • Research institution turned investor
    • Could not pull the trigger
  • Ex-funder partner ⇄ disaster
  • Cowboy businessman partner ⇄ fair but unpredictable
Gen-1 AEROSEAL Machine

1999: First Commercial Product sold to HVAC Dealers
From the Lab to the Real World

- Block all grilles temporarily
- Pressurize duct system with aerosolized sealant
- Track process to watch it working
From a Technology to a Business

• Provide technician with immediate feedback
• Provide customer with proof of performance
• Assure that your business model creates revenue
  • Dealers pay by the application
  • Forced to upload data for machine to work
Industry Recognition: ASHRAE Standard 152

Technology-Agnostic Legitimization

- Test Procedures
- Design Efficiency Calculations (Performance)
- Seasonal Efficiency Calculations (Energy Savings)
Leakage Data

Statistical Demonstration of Problem

Pre-Sealing Duct Leakage

Leakage [cfm@25Pa]

Sacramento A (443) | Sacramento B (279) | Sacramento C (110) | Bakersfield NEW (1231) | Illinois (1065)
Solving Unrecognized Customer Problem: Diagnosis

Total Register Flowrates

EXPECTED Flowrate ~400 cfm/ton

Flow [cfm/ton]

Sacramento A (2159)  Sacramento B (1898)  Sacramento C (556)  Bakersfield (47)  Illinois (42)

Needed to produce complete diagnostic protocol to show value

VALUE PROPOSITION: Customers Not Getting the FLOW
Solving Unrecognized Customer Problem: Diagnosis

Registers with >25% Thermal Loss

Customers Not Getting the desired TEMPERATURE
Utility Survey of HVAC Satisfaction

Customer Satisfaction and 3\textsuperscript{rd} Party Verification
Make the Difference
Smaller Particles and More Sealant Flow Sped Up Sealing by Factor of 5-10

Modular Design Facilitated Application in Commercial Buildings
Aerosealing Large Commercial Ducts – Bldg 90
Aerosealing Large Commercial Ducts - LBNL Building 70

- LABORATORY Dual Deck Supply Sealing
Aerosealing Large Commercial Ducts -LBNL Building 50

- Supply Shaft Sealing
Aerosealing Large Commercial Ducts - LBNL Building 50

- Supply Shaft Sealing
Start-Up to Start-Up

STEP 1: Sold company to large corporation
- 16-month negotiation process – very time-consuming
  - Terms and Conditions are king
  - Opportune and Inopportunne sale timing
    - 2 weeks before 9/11/2001

STEP 2: Pluses and Minuses of a large corporation
- Professionalization and credibility
- Distribution network
- Aeroseal was in the financial noise
- Evolution of corporate personnel and priorities

STEP 3: Nine years later
- Contract made corporate divestiture work
- Alternative was complete write-off
- Welcome to the world of private finance
Commercial-Building Sealing – 12 years later

Health Care/Labs
- Mayo Clinic
- Sutter Health
- 3M
- Kantonsspital Baden
- NYU Medical Center
- Healthpoint
- Sentara Healthcare
- Kaiser Permanente
- Trinity Health System
- Nemours Children's Hospital
- Banner Health

Government
- Department of Defense
- United States Navy
- United States House of Representatives
- U.S. Army

Higher Ed
- University of California, Berkeley (Cal)
- University of Miami
- Penn Medicine
- Princeton University
- Indiana University
- Harvard University
- Ohio State University

Property Mgmt
- Related
- Hyundai
- DIFC
- ITYcenter
- Rose Associates
- AyalaLand
- Related Malls
- Tibbix

Hospitality
- Disney
- Accor Hotels
- Wynn Las Vegas
- Marriott

UC Davis University of California
Product Improvement: Current Aeroseal Residential Equipment
New Technology: Building Envelope Sealing

Basic Concept

• Seal New-Construction Building Shells at Rough-In
• Seal Existing Construction at time of occupancy change, or from attic and/or crawlspace
• Reduce cost, get better tightness and get automated certification
Aerosol Building Sealing
Post-Sheetrock Sealed Leaks
Pre-Sheetrock Sealed Leaks
Aerosol Envelope Sealing
Comparison with Manual Sealing

Manual sealing accomplished by 3 contractors over 8 hours
Aerosol Building Sealing

Leakage Flowrate at 50 Pa [CFM] vs. Elapsed Time [Minutes]
Aerosol sealing dramatically reduces sound transmission above 800 Hz.
From the Lab to Market (Round 2)

STEP 1: Licensing

• Not as hard this time
• Seven firms interested in licensing
• Aeroseal ultimately got the license
  • Conflict of interest kept me out of the process

STEP 2: Addressing Large Range of Applications

• Need technical sophistication
• Need market partners
• Not yet clear how it will work out
WCEC MISSION

“Accelerate the development and commercialization of efficient heating, cooling, and energy distribution solutions through stakeholder engagement, innovation, R&D, education, and outreach.”

Would have accelerated the Aerosol Commercialization Process
ANY QUESTIONS?