Weishaupt –
Low NOx Solutions for
Boiler Applications

Presentation by Greg Meyer        Ottawa, 2003

- weishaupt -

Content

• Weishaupt Company and Products
• Weishaupt Low NOx Solutions
• Applications
Max Weishaupt GmbH

- 150,000 burners / year sold in more than 60 countries
- 3,000 employees
- Service and support worldwide
- Burners are engineered to meet approvals and emission requirements for each country
- > 4 million burners
Research and Development

- Established in 1962
- One of the largest privately owned research facilities
- 100 full time engineers plus support staff keeps Weishaupt burners at the leading edge of technology
- Several sizes of units to match the capacity requirements

- weishaupt -

Research and Development

- All products are developed internally
- Custom Fuels are blended to match site specifications
- Combustion fan testing in a pressurized chamber to determine fan curve characteristics
Quality

- Priority No.1
- Checks for quality and consistency
- Latest equipment

Product Line

- **W Series**
  - max 2,000 MBH

- **Monarch Series**
  - max 37,000 MBH

- **WK Series**
  - max 60,000 MBH
Content

• Weishaupt Company and Products
• Weishaupt Low NOx Solutions
  • Efficiency throughout the Capacity Range
  • NOx reducing Design Features
• Applications
**Efficiency throughout the Firing Range**

- What is the most effective method of reducing emissions?
  - By burning less fuel.
- How does Weishaupt reduce fuel consumption?
  - By manufacturing high efficiency burners.
- How has Weishaupt accomplished this?
  - By investing heavily in R&D and employing high quality manufacturing methods

---

**Complete (Stoichiometric) Combustion**

![Chemical equations for complete combustion](image)
Incomplete Combustion

Single carbon atoms combine with single oxygen atoms to produce carbon monoxide (CO):

Insufficient air results in:
- Explosion Danger
- Toxic Carbon Monoxide
- Fuel Wastage

Combustion Efficiency

- Low O2 in flue gas means high energy gain & high efficiency.
Control linkages

- The control linkages on a burner are critically important since their function is to control the fuel to air ratio throughout the firing capacity of the burner.
- In order to maximize efficiency and ensure repeatability, control linkages must be well designed with a minimum of hysteresis.
- Excessive “play” has a detrimental effect on how well a burner can be tuned and therefore directly affects the burner and boiler efficiency.
Control linkages

- FUEL AIR CONTROL DRIVE MOTOR
- AIR CONTROL DAMPER
- COMBUSTION AIR DAMPER DRIVEN DIRECTLY FROM MOTOR SHAFT (NO HYSTERESIS)

FUEL CONTROL VALVE

BURNER OPERATES WITH LEAN MIXTURE

- FUEL AIR CONTROL DRIVE MOTOR MOVES 5° TOWARD HIGHER FIRING RATE
- AIR CONTROL DAMPER MOVES OPEN 5°
- COMBUSTION AIR DAMPER DRIVEN DIRECTLY FROM MOTOR SHAFT (NO HYSTERESIS)

FUEL CONTROL VALVE REMAINS IN SAME POSITION BECAUSE OF HYSTERESIS
Control linkages

**BURNER OPERATES WITH LEAN MIXTURE**

- Fuel air control drive motor moves additional 5° toward higher firing rate.
- Air control damper moves open additional 5°.
- Combustion air damper driven directly from motor shaft (no hysteresis).
- Fuel control valve moves.

Control linkages

**BURNER OPERATES WITH RICH MIXTURE**

- Fuel air control drive motor moves 5° toward lower firing rate.
- Air control damper moves closed 5°.
- Combustion air damper driven directly from motor shaft (no hysteresis).
- Hysteresis 5°.
- Fuel control valve remains in same position because of hysteresis.
Control linkages

- Very low hysterises linkages

- Cast aluminum cam with needle roller bearing cam followers

- Linkage – less system with individual servodrives for each function accurate to 0.1 deg
Quality Features for high Efficiency

- High temperature stainless steel flame tube
- Precisely manufactured combustion head components
- Very simple service

Design Features for High Efficiency

Adjustable flame tubes allows burners to be optimized for the specific application and allows higher turndown ratio for increased efficiency

? P through the flame tube should be maximized
Design Features for High Efficiency

Variable head geometry - maintains pressure drop throughout entire firing range

- Major Benefits:
  - Increased efficiency with higher turndown ratio

Turndown Ratio

- High Fire
- 4:1
- 10:1

Burner stops
Burner starts

Heat & Load Loss
Post Purge
Pre Purge

Required Output
Actual Output
<table>
<thead>
<tr>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Weishaupt Company and Products</td>
</tr>
<tr>
<td>• Weishaupt Low NOx Solutions</td>
</tr>
<tr>
<td>• Efficiency throughout the Capacity Range</td>
</tr>
<tr>
<td>• NOx reducing Design Features</td>
</tr>
<tr>
<td>• Applications</td>
</tr>
</tbody>
</table>

**Forced Flue Gas Recirculation**

![Forced Flue Gas Recirculation Image]
**Fuel Staging**

- Mixing heads designed to meet various NOx requirements

---

**Internal Recirculation**
**Combined Technologies**

**multiflam® Oil Flame**
- weishaupt -

multiflam®

- Low emissions on gas and on oil
- No induced flue gas recirculation
- 1,000 – 40,800 MBH
multiflam® Gas

**NOx Emissions in ppm**

Capacity in MBH

- Natural Gas
  - NOx Emissions in ppm
  - Capacity in MBH

multiflam® Oil

**NOx Emissions in ppm**

Capacity in MMBH

- Fuel #2 Oil
  - NOx Emissions in ppm
  - Capacity in MMBH
Low NOx Oil Burner vs. Standard Burner

Low NOx Burner Models

- weishaupt -
Weishaupt Low NOx Burners provide:

- Reduced Operating & Maintenance
- Increase in Boiler Efficiency
- No Reduction in Turn-Down
- No Reduction in Output Capacity
- No Reduced Boiler Life
- NOx reduction with Gas, Oil and Dual Fuel-Burners
Content

• Weishaupt Company and Products
• Weishaupt Low NOx Solutions
• Applications

Case Study

• Process Steam Boiler
• Texas NOx Requirements < 30 PPM
• High maintenance costs
• NOx Levels > 35 PPM

BEFORE:
• Efficiency (Average) 76.5%
• NOx 38 PPM
• CO > 100 PPM

AFTER:
• Efficiency (Average) 82.5%
• NOx <25 PPM
• CO < 10 PPM
• Increased Turndown Ratio
• Reduced Electrical Consumption
Boiler Efficiency

Abstract:
A boiler operates for 8,000 hrs per year and consumes 500,000 MMBtu of natural gas while producing 45,000 lb/hr of 150 psig steam. Stack gas measurements indicate an excess air level of 44.9% with a net flue gas temperature of 400°F. From the table, the boiler combustion efficiency is 78.2% (E1). Tuning the boiler reduces the excess air to 9.5% with a net flue gas temperature of 300°F. The boiler combustion efficiency increases to 83.1% (E2) Assuming a steam value of $4.50/MMBtu, the annual cost savings are:

Cost Savings = Fuel Consumption X (1 – E1/ E2) X steam cost = 29,482 MMBtu/yr X $4.50/ MMBtu = $132,671.00 US annually.

Source: U.S. Department of Energy
Boilersmith

Dominion Bridge Retrofit
Rimouski – Before and After

Powermaster Retrofit
Cleaver Brooks Retrofit

Weishaupt Canada

Weishaupt Corp.
6280 Danville Road
Mississauga, On L5T 2H7
Phone: (905) 564 0946
sales@weishaupt-corp.com
Weishaupt Canada

Weishaupt Corp.
6280 Danville Road
Mississauga, On L5T 2H7
Phone: (905) 564 0946
sales@weishaupt-corp.com