JUPITER OXYGEN CORPORATION

MAKING ENERGY MORE EFFICIENT

JUPITER ALUMINUM CORPORATION

ENHANCED ENERGY EFFICIENCY AND EMISSION REDUCTION THROUGH ADVANCED OXY-FUEL TECHNOLOGY IN THE ALUMINUM REMELTING INDUSTRY

TMS Conference

New Orleans, LA

March 12, 2008

Oxy-Fuel Research Program for Aluminum Remelt

Background & Motivation

Jupiter Oxygen is committed to innovative – **energy efficient and environmental responsible technologies** – focusing on improvements for energy intensive businesses like:

- **Aluminum production**
- **Power generation**
- **Waste transformation processes**

Technology Development by Entrepreneurship

Starting in the 1990s
Dietrich Gross, *Chairman & CEO of Jupiter Aluminum Corp.,* focused on:

- **energy efficiency gains**
- **cost savings**

within the **process heating** in his aluminum recycling facility.

Development through research and cooperation

Scientific Approach & Practical Experience

- Extensive experiments with the use of oxygen in industrial melting furnaces were applied in day-to-day operations
- Knowledge from these experiments led to a patented process for advanced combustion and burner systems:
- Private-Public R&D Program in Cooperation with U.S. DOE over 15 million (US) dollar investment

To Develop, Establish and Promote Jupiter's Technology

- Patenting technology worldwide
- Working with equipment suppliers
- Working with Industry

Conventional Combustion

- **Traditional**
  - Air fuel fired 21% oxygen, 79% nitrogen
  - 3 to 5% excess air
- **Relatively Low Flame Temperature**
- **Readily Available Nitrogen to Create NO_x**
- **Nitrogen Robs Heat from the Process**

Oxy-Fuel Misconceptions

- Flame temperature or heat input is uncontrollable
- Economics and scale not obtainable
- Furnace design and materials need to be changed
- The process was not taken into account
- Inclusions / impurities in the re-melted aluminum would increase
- Dross generation would change
- Melt loss due to high temperature and oxygen

Jupiter's Solution

1. Energy transfer design, radiation and convection understanding
2. Properly designed combustion system
3. Maintaining existing process variables
4. Stoichiometric ratio
5. Reduce energy input to match efficiency increase
6. Economics of producing your own oxygen [can trade-off capital costs for higher operating costs]

Oxy-Fuel Combustion

$$CH_4 + 2O_2 = CO_2 + 2\,H_2O$$

Jupiter's Best Practice Development

Jupiter's technology is a…

- patented process for the combustion of fossil fuels with **pure oxygen**
- using an undiluted high flame temperature, but keeping the same process temperatures
- existing furnace materials can mostly be used and the same melting temperatures are maintained

Aluminum Applications, Best Practice & Benefits

- **Secondary Aluminum**
  - **Re-melting & Holding furnaces**
  - **Dross Recovery**
  - **Co-production**
    - **Nitrogen**
    - **Argon**
- **Primary Aluminum**
  - Alumina Calcinations Processing
  - Power Generation
  - Co - Production

Recycling and Dross Recovery – Significant Energy Efficiency Gains through Advanced Combustion

Dr. Subodh Das (SECAT, 2004):

… process heating and burners offer major energy saving opportunities (60% – 80%) in secondary aluminum industry plants…

… process heating consumes more than 70% to 85% of the total energy used for the secondary aluminum industry

Oxy-Fuel: Best Practice Technology

- **Improved Energy Efficiency**
  - 750-900 Btu/lb for continuous runs
  - Elimination of airborne nitrogen
  - More radiant heat transfer
  - Longer gas residence time
- **Lower Fuel Costs**
  - Natural gas fuel reduction up to 73%
  - Oil fuel usage reduction up to 68%
- **Improved Production**
  - Better heat transfer

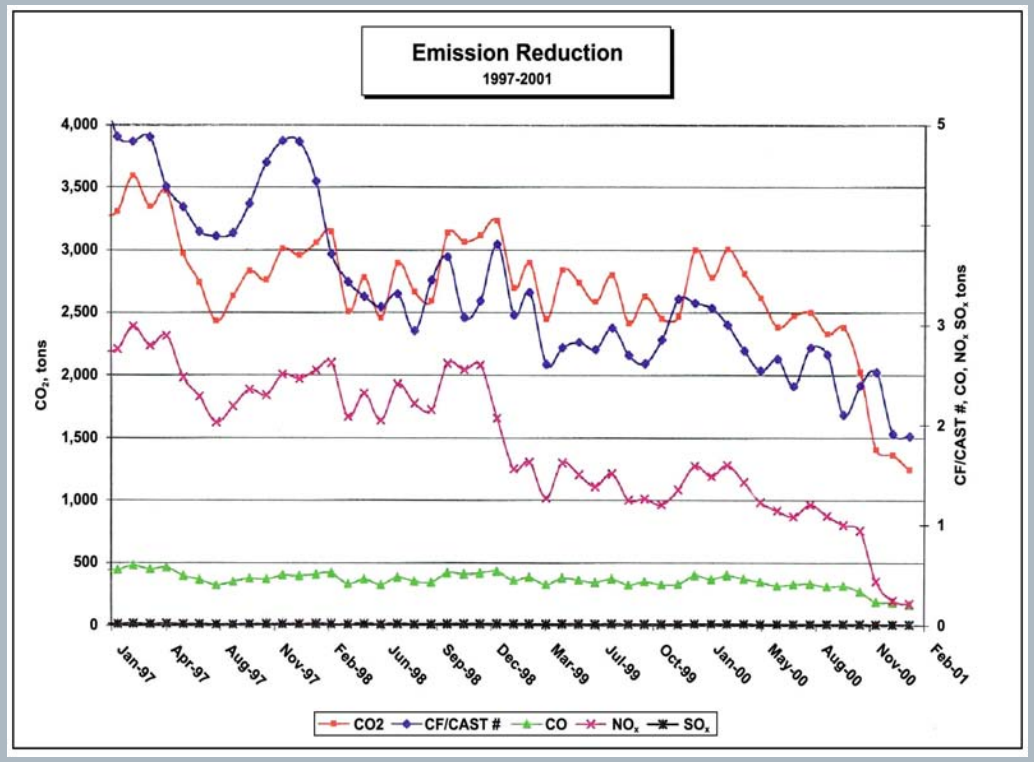
Actual Results from Retrofit of plant

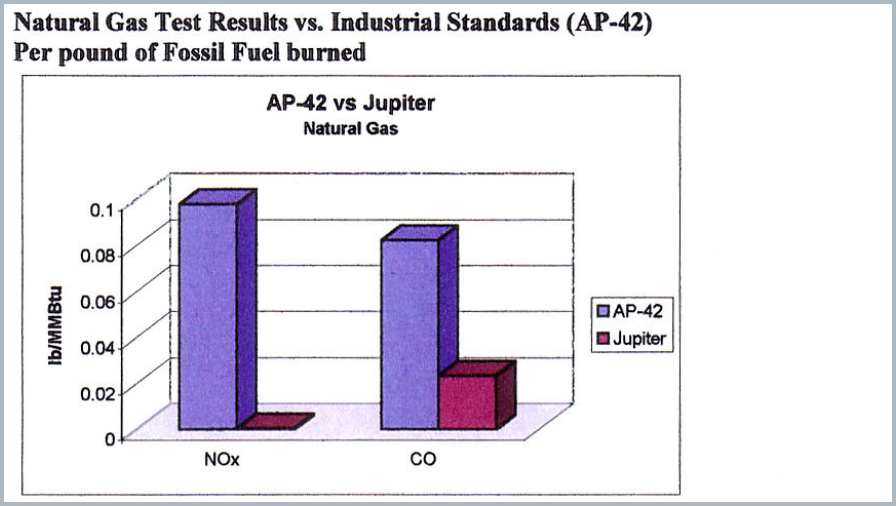
Year	Estimated Casted Aluminum Pounds	Production FCE Natural Gas MMBtu	Waste Oil MMBtu	Waste Oil Gallons	Percent Oxy-fired	CO2 - Oil TPY	CO2 - NG TPY	CO2 TPY
1997	134,797,919	605,370.38	**0**	**0**	**0.00%**			
1998	164,041,703	570,063.62	0	0	**26.90%**	0	32,001	32,001
1999	181,984,940	441,750.48	0	0	**46.00%**	0	24,798	24,798
2000	184,773,584	400,809.52	0	0	**53.50%**	0	22,499	22,499
2001	161,286,676	125,018.00	84,516	612,742	**100.00%**	5,930	7,018	12,948

Emission Reduction with Oxy-fuel Technology Application

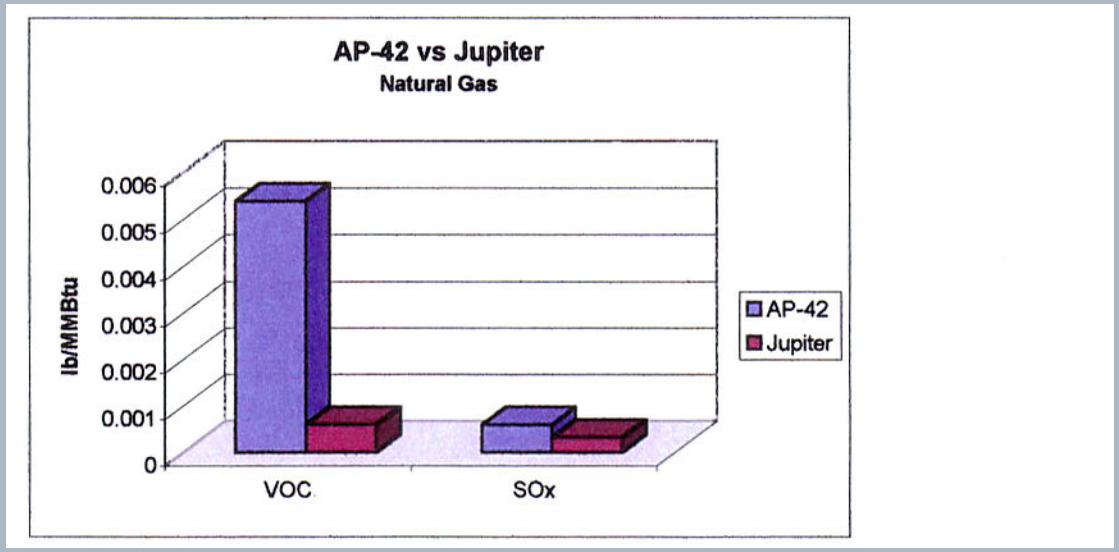
Emission reduction based on realized percentage of oxy-fuel technology application at JAC:

1997:	0%
1998:	27%
1999:	46%
2000:	54%
2001:	100%





- Graph 1: NOx AND CO REDUCTION, FIRING OXYGEN & NATURAL GAS



Graph 2: VOC AND SOx REDUCTION, FIRING OXYGEN & NATURAL GAS

Clean Technology Investment Costs

Retrofit Industrial User with 250,000,000 lbs Production/year

- Would require a capital investment US dollars of $5,000,000
  - Cryogenic Plant $3,500,000 [used]
  - Combustion System(s) $1,500,000

→ **The timeline for retrofit completion would be 12 to 18 months**

40 MMBtu per hour fuel usage per furnace:

- 320,000 MMBtu annual energy savings [$2,400,000]
- **$1,740,000 net operational savings per year** [Natural gas US $7.50/MMBtu; - $660,000 electricity costs for oxygen production]
- **15,000 tons net CO_2 - avoidance from fuel savings per year**

→ **Payback time for investment 2 to 3 years based on fuel savings**
other revenue streams possible from using the nitrogen, argon….

Conclusion and Outlook Aluminum Production

- Results from Jupiter's technology implementation at an U.S. based Aluminum Recycling Facility show a documented success story based upon energy efficient and low cost production
- Technology transfer of oxy-fuel combustion to other high energy intensive industrial processes with furnaces and kilns like alumina calcinations and waste transformation processing are likely to show similar energy efficiency gains and equivalent cost savings

JUPITER OXYGEN CORPORATION

MAKING ENERGY MORE EFFICIENT

JUPITER ALUMINUM CORPORATION

Visionary Innovation | Scientific Approach | Operational Experience

WEB: www.jupiteroxygen.com

WEB: www.jupiteraluminum.com

Jupiter Oxygen Corporation
4825 N Scott St Suite 200
Schiller Park, IL 60176 USA

Jupiter Aluminum Corporation
1745 - 165TH Street
Hammond, IN 46320 USA