

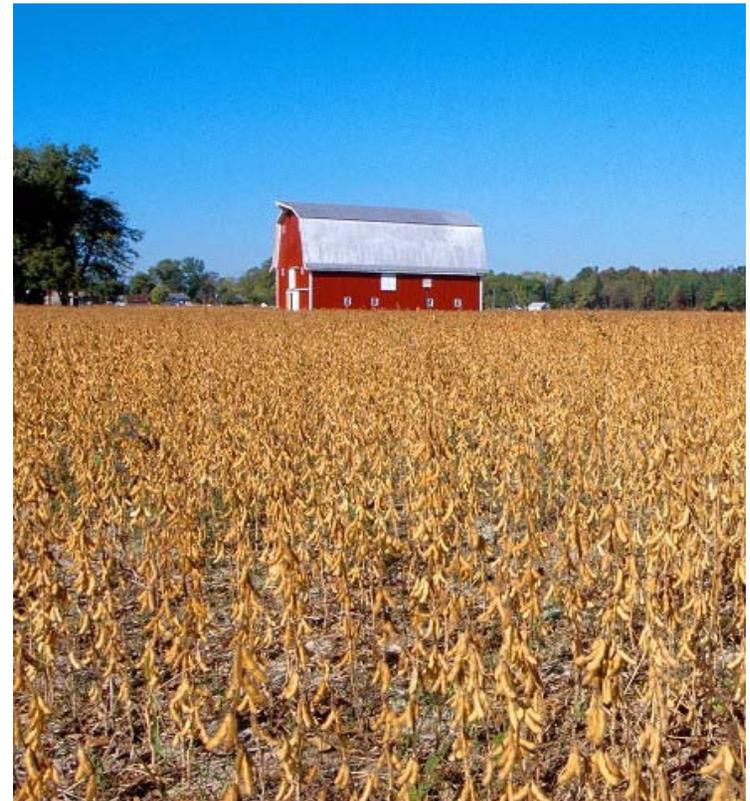
Soybean Oil as a Home Heating Fuel Alternative



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Outline

- Support
- Objectives
- Soybeans
- Furnace Tests
- Heat Energy Tests
- Preliminary Results



Scott Bauer, USDA ARS

Project Support

- **USDA/CSREES**
 - **IFAFS - Initiative for Future Agriculture and Food Systems**
- **ISB - Indiana Soybean Board**

Objectives

Test heating oil blend containing crude, degummed, or soy methyl esters for the following:

- Use in residential furnaces with minimal modifications
- Reduce combustion emissions
- Beneficial to the agricultural industry
- Provide economic benefits to all oil heat users

Soybeans?

□ Kernel composition

- 19% Oil
- 35% Protein
- 5% Fiber

Purdue, AgCom

□ Bushel weighs 60 lbs

- 11 lbs of oil
- 48 lbs of protein meal

Purdue, AgCom

□ Valuable products

- Human consumption
- Livestock feed
- Industrial Applications

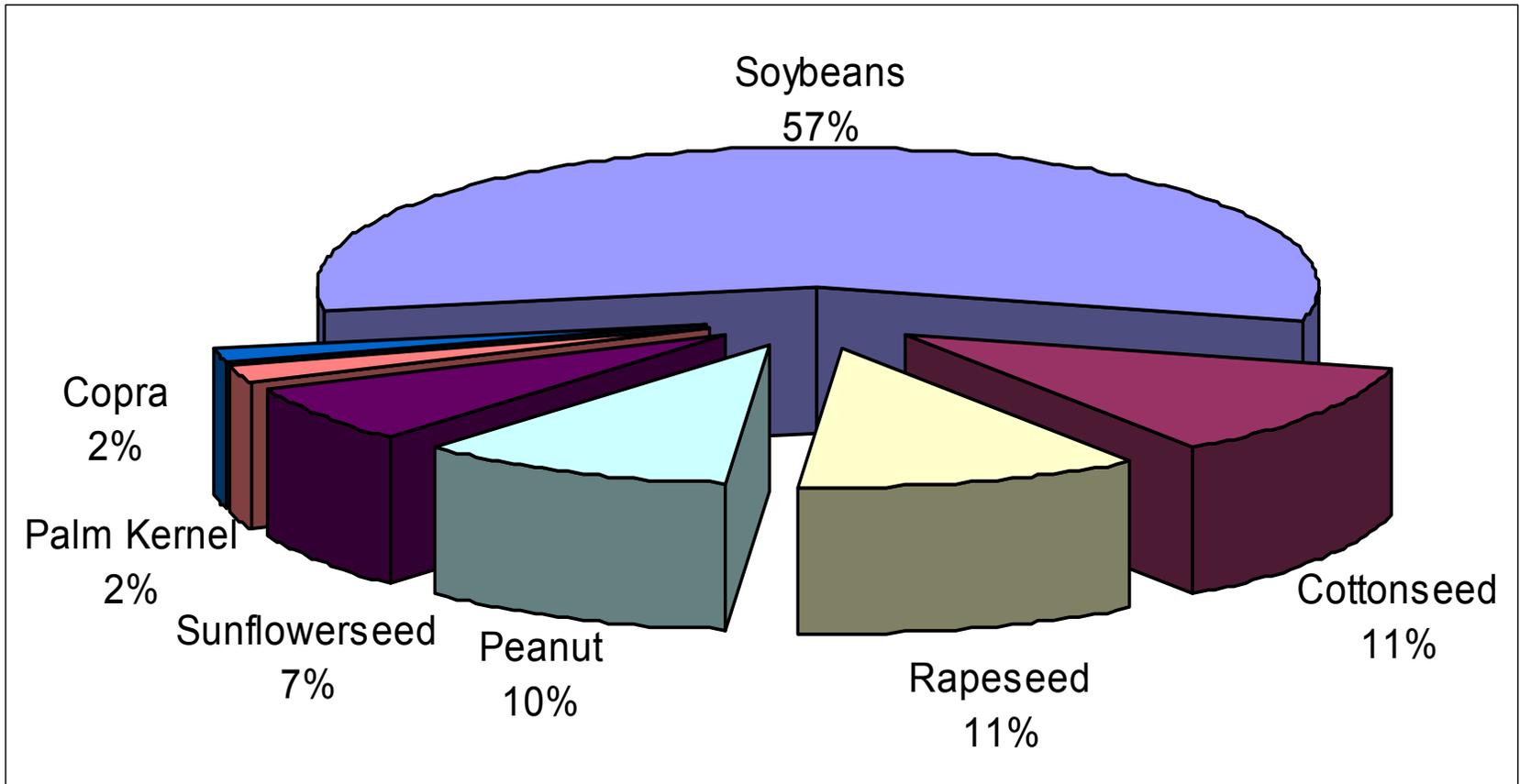


Scott Bauer, USDA ARS



Pammark Farms, Ltd.

2001 Worldwide Oilseed Production



2002 U.S. Production

- Soybean production
 - 72.16 million acres harvested
 - **\$14.75 billion**
- Soybean oil production
 - 21.81 billion pounds
 - **\$4.80 billion**

Source: USDA-NASS



Soybean Oil Types

- ❑ Crude(SHOxx)
 - Extracted using mechanical or chemical means
 - Contains meal residue, dirt, hydrated phosphatides
 - Sensitive to oxidation
 - Suitable environment for microbes

- ❑ Degummed(SHOxx)
 - Washed crude oil
 - Removes 80-90% of original lecithin
 - Suitable for transit, storage, or further refining

- ❑ Soy Methyl Esters(Bxx)
 - Transesterified oil rearranges the fats without chemically modifying fats
 - Removes glycerols
 - Improved cold flow properties

10 Year Price History

	Soybean Oil
	\$/gal
Average	\$1.47
Max.	\$1.92
Min.	\$0.99

SHO20 blend in Midwest

- **803 million** gallons of petroleum based heating oil consumed in 1999

- Oil production requirements
 - **160 million gallons of soybean oil**
 - 5.1% of total U.S. soybean oil production

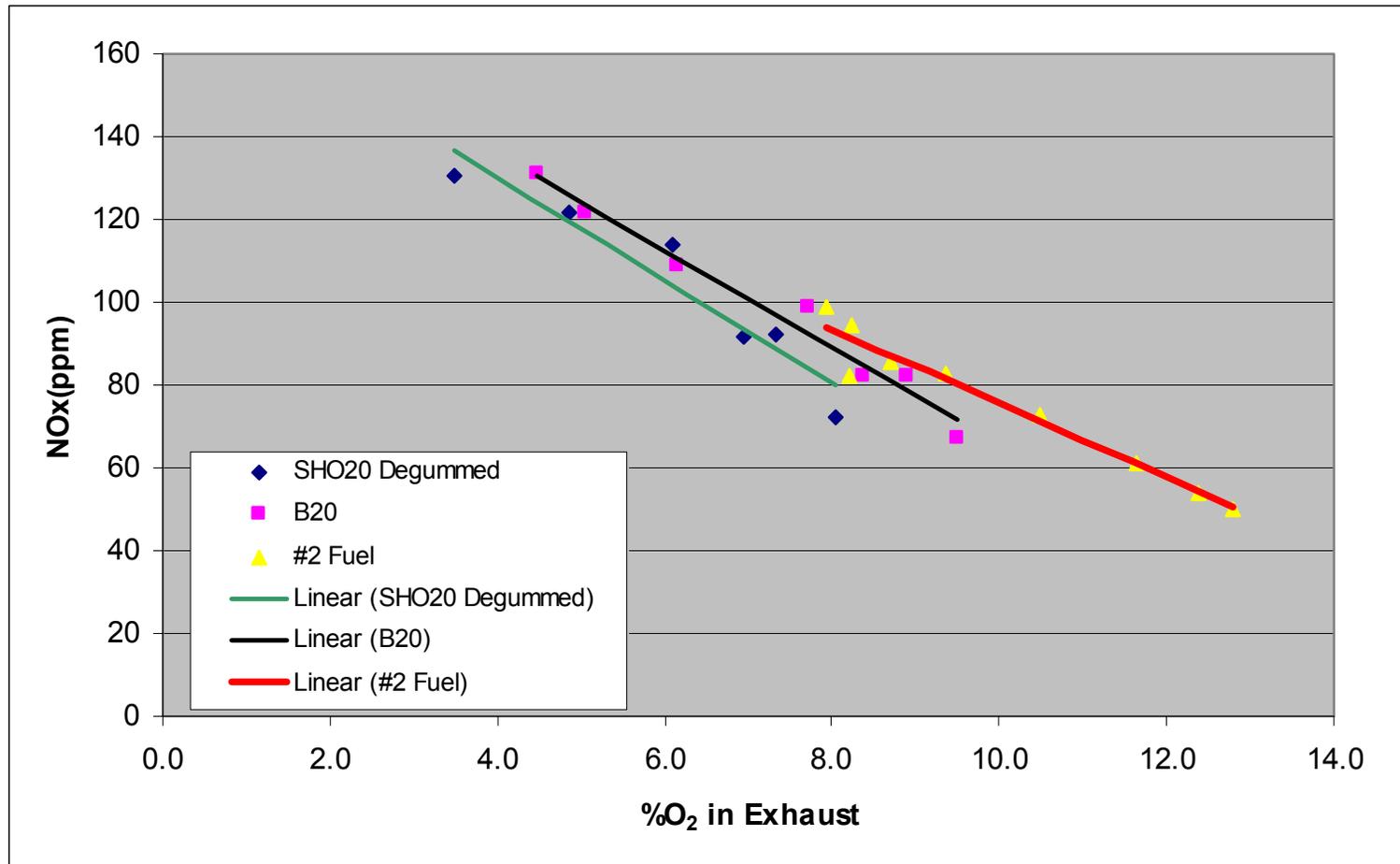
- Farmland requirements
 - **3.15 million acres would be required**
 - 4.4% of total U.S. harvested acres

Research – Furnace Tests

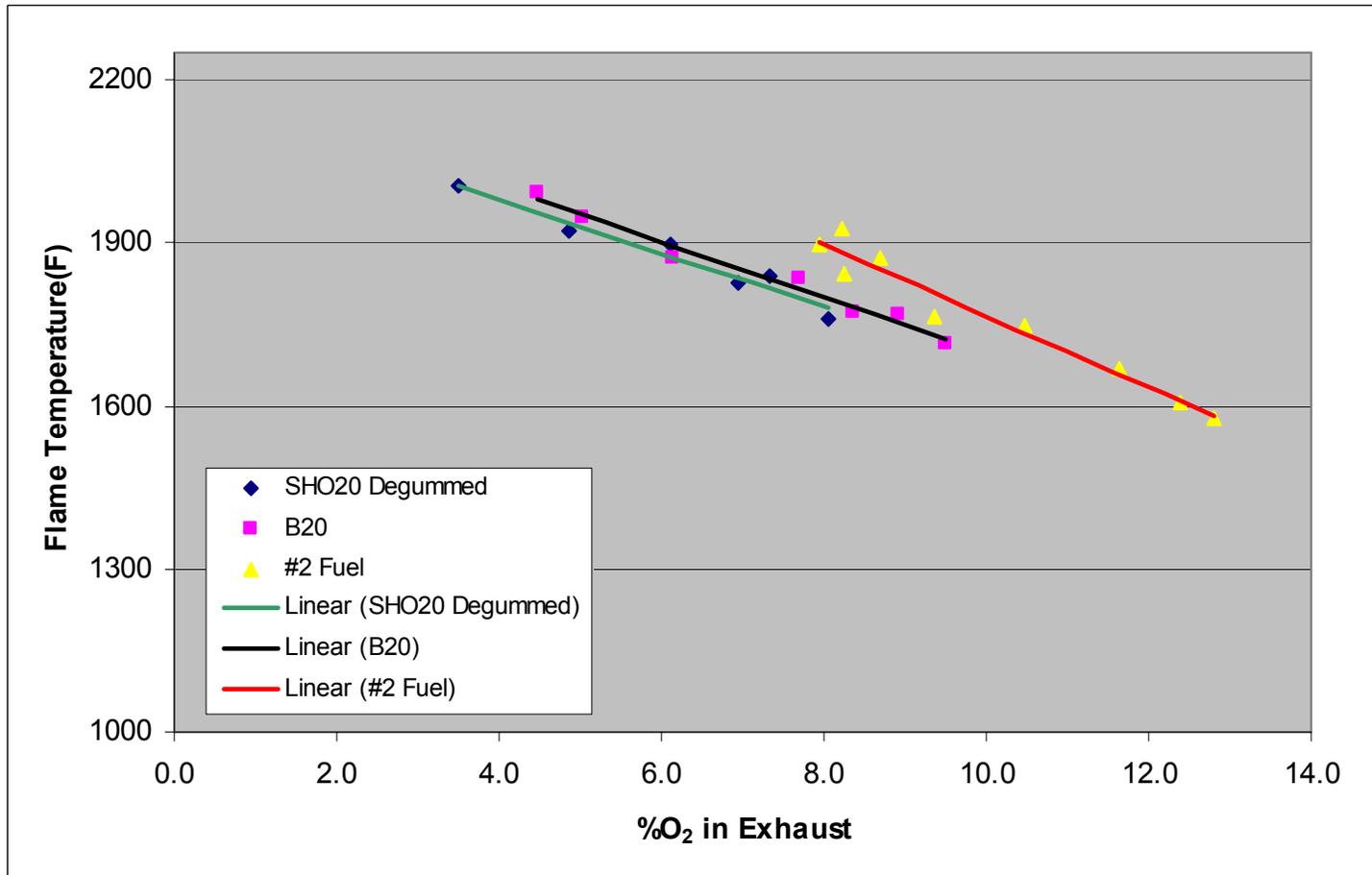
- ❑ Thermo Pride furnace with Beckett model AF burner
- ❑ IMR 2800 Combustion Analyzer
 - Measured Parameters
 - ❑ NO and NO₂
 - ❑ O₂
 - ❑ CO
 - ❑ SO₂
 - Calculated Parameters
 - ❑ Heat losses
 - ❑ Excess Air
 - ❑ CO₂
 - ❑ mg/m³, mg/m³ (Ref.O₂)
 - ❑ NO_x (NO+NO₂)



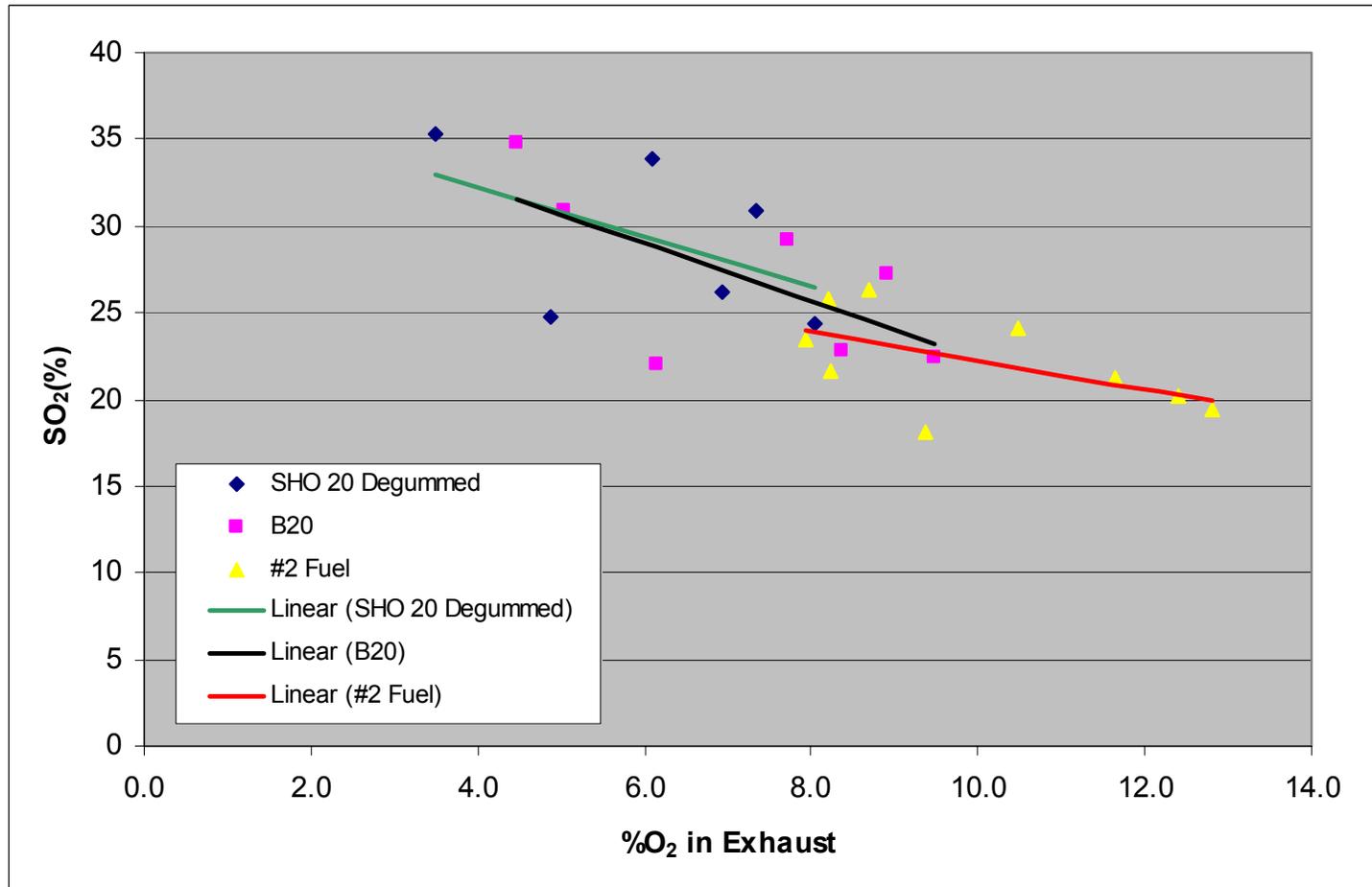
NO_x Emissions



Flame Temperature



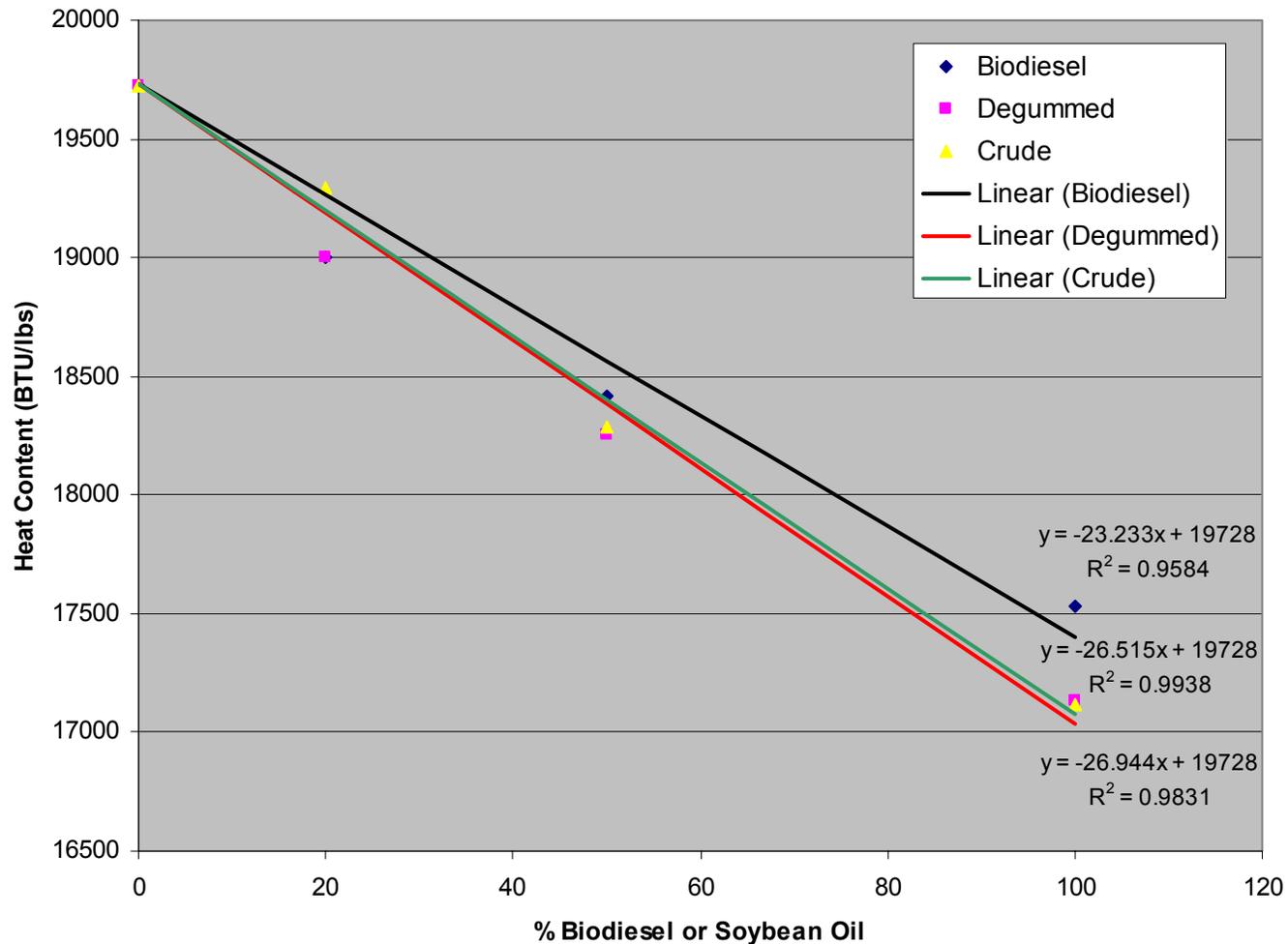
SO₂ Emissions



Furnace Test Results

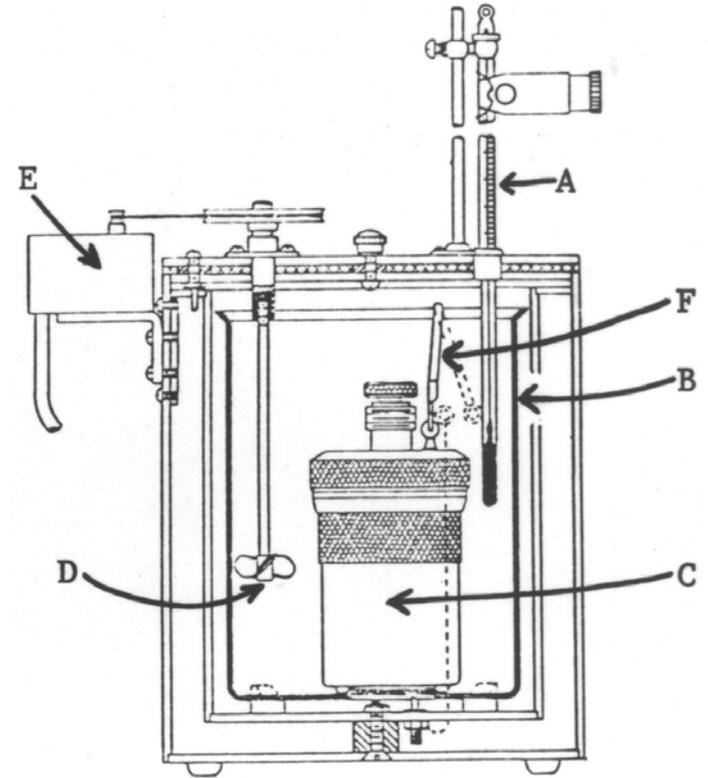
- ❑ NO_x emissions lower for both B20 and SHO20 compared to heating oil
- ❑ Flame temperature lower for both B20 and SHO20 compared to heating oil
- ❑ SO₂ emissions inconclusive
- ❑ Successfully burned 50% blends with no modification to furnace equipment

Research – Heat Energy Content



Heat Energy Content Results

- B100 contains greater than 400 BTU/lb over both crude or degummed SHO100
- B100 showed 11-12% decrease in heat energy from Heating Oil to B100
- SHO100 oil show 13-14% decrease in heat energy from Heating Oil to SHO100



Cross Section of Series 1300 Plain Calorimeter

Conclusion

- ❑ Soybean oil blends are promising
- ❑ Reduce combustion emissions
- ❑ Potential economic benefits for all users
- ❑ Beneficial to the agricultural industry

Questions?

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