

*New Generation of Sol-Gel Coatings
'ThermolonTM'*

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Imagine...

A coating that fires at 600 °F
Is thermally stable up to 850 °F
Is water based and green
&
Is non-stick to 475 °F



Sol-Gel Coatings is the Answer!!

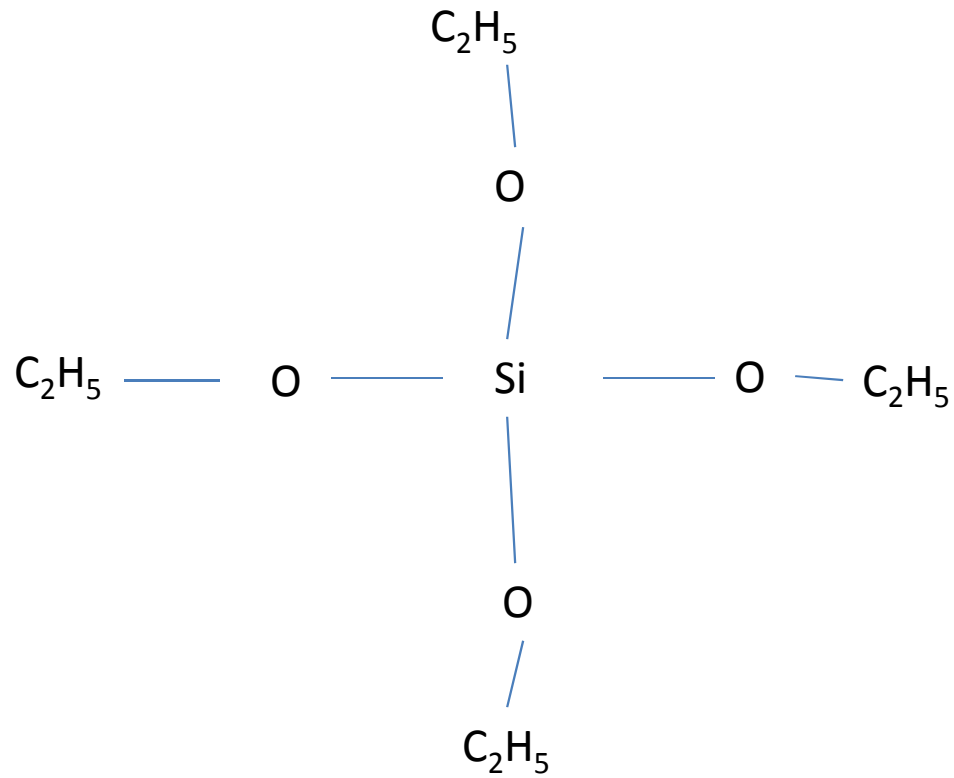


Process for Sol-gel Coatings

- Process for manufacturing glass like coatings through colloidal suspensions (“sols”), converted to viscous “gels” and then to solid materials
- Typically involves a Silicon alkoxide such as [Tetraethoxy silane](#) (TEOS) as a precursor. The polymerization reaction involves three key steps:



Tetra Ethoxy Silane

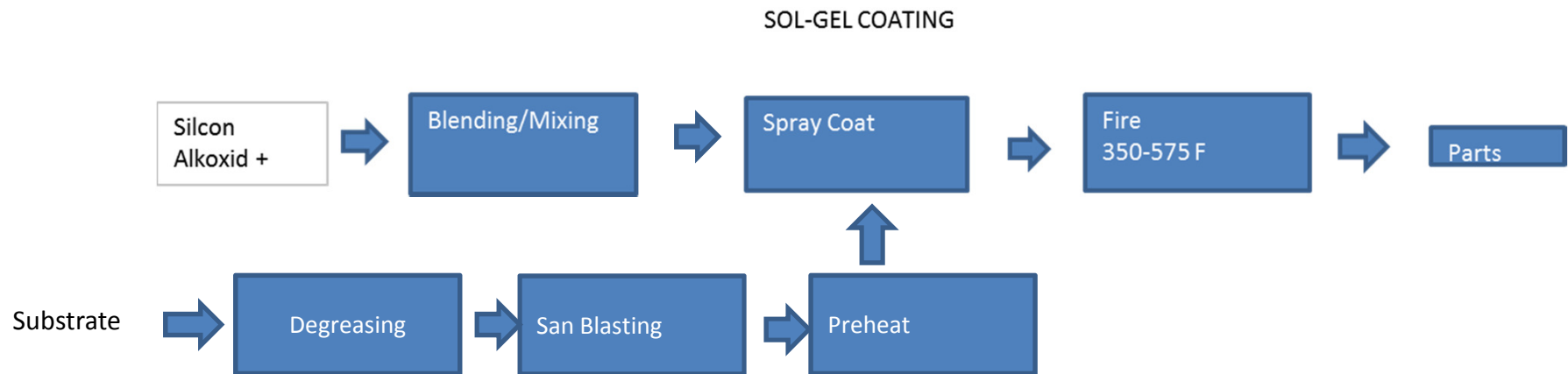
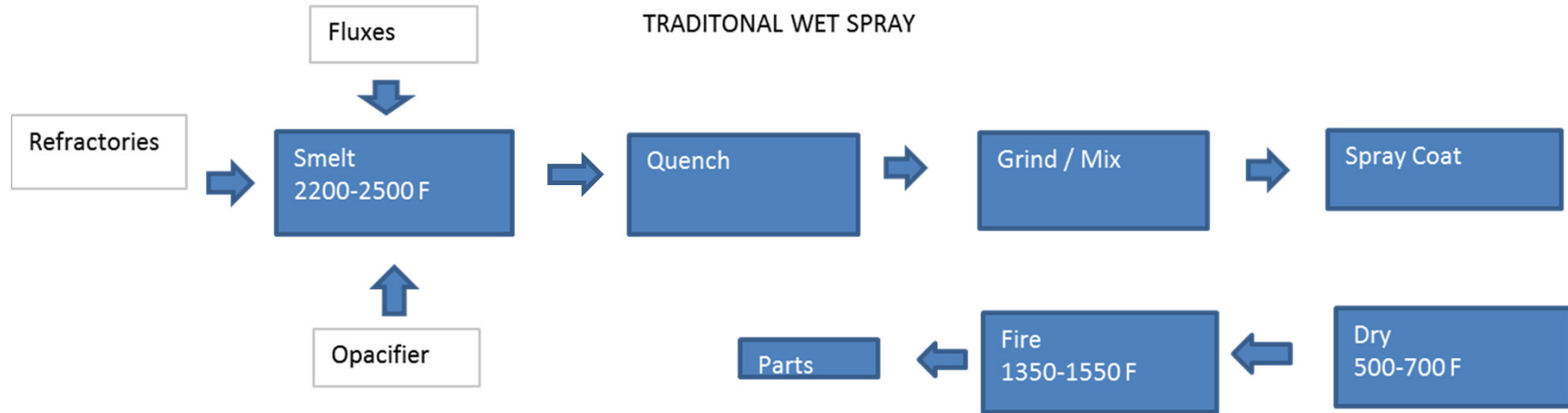


Thermolon™ Family of Coatings

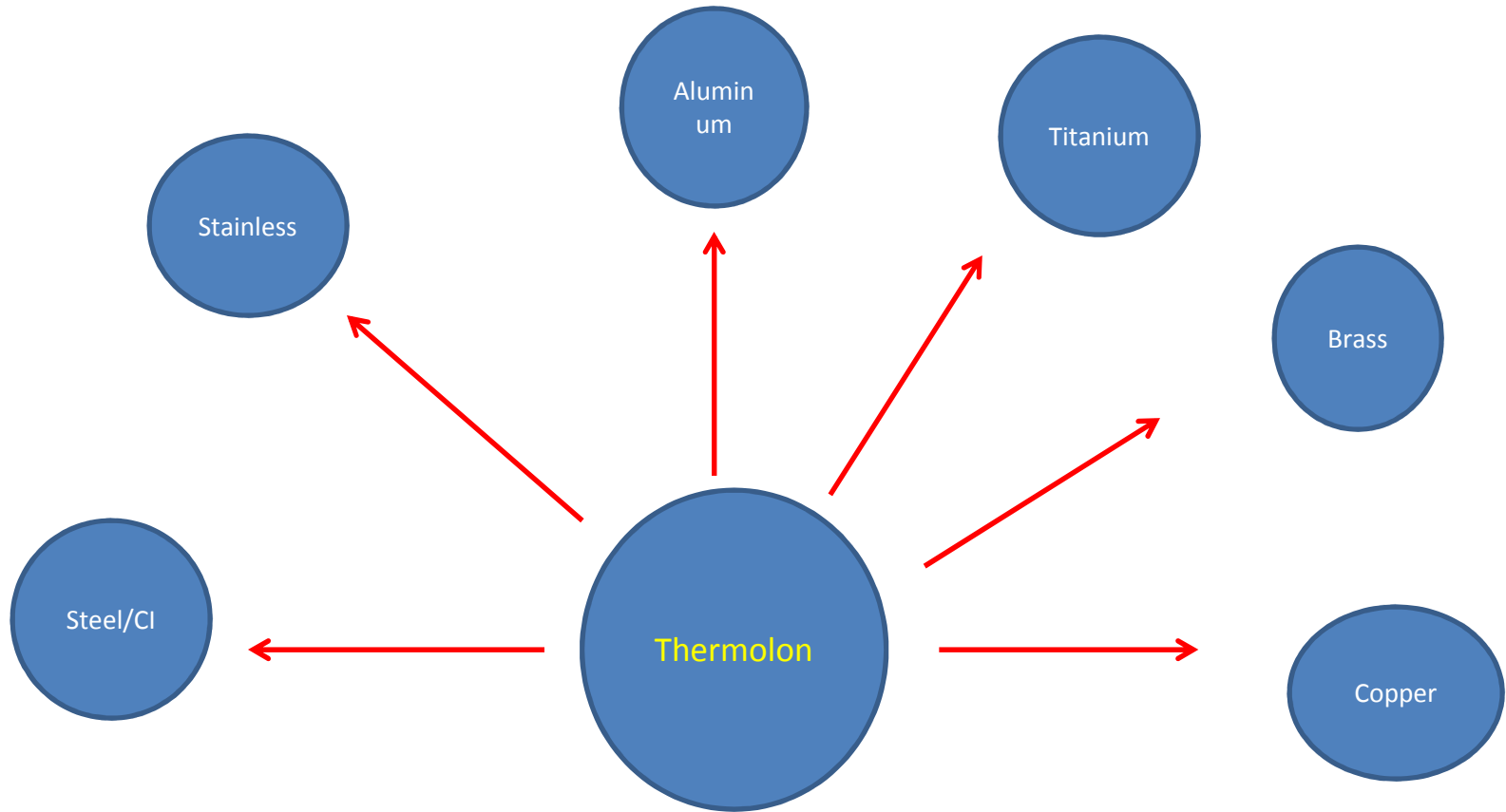
- Research in Sol-gels over the past 20 years in Germany, UK, Australia, Belgium, Korea
- Thermolon™ was born as a South Korean company to commercialize thermal sol-gel coatings in 2005
- Today Thermolon™ coated products are sold in over 80 different countries
- Wide variety of formulations for different end use applications
 - Nonstick
 - Flexible
 - Higher temperature, high abrasion resistance



Comparison of Enameling and Sol-Gel Coating Processes



Substrates



Properties of Thermolon™ Coatings

- Superior non-stick properties
 - Perfect release for fried egg, burnt milk and burnt sugar
- Scratch and abrasion resistance
 - 9H Pencil hardness
 - Up to 59,000 cycles on abrasion pad v/s 5000 for PTFE
- Very high acid resistance
 - No weight loss for sulfuric acid test
- High heat resistance
 - Capable of withstanding 450 °C v/s 260 °C for PTFE
- Stain resistance and good clean-ability
 - Shown excellent stain resistance on burners at higher temperatures



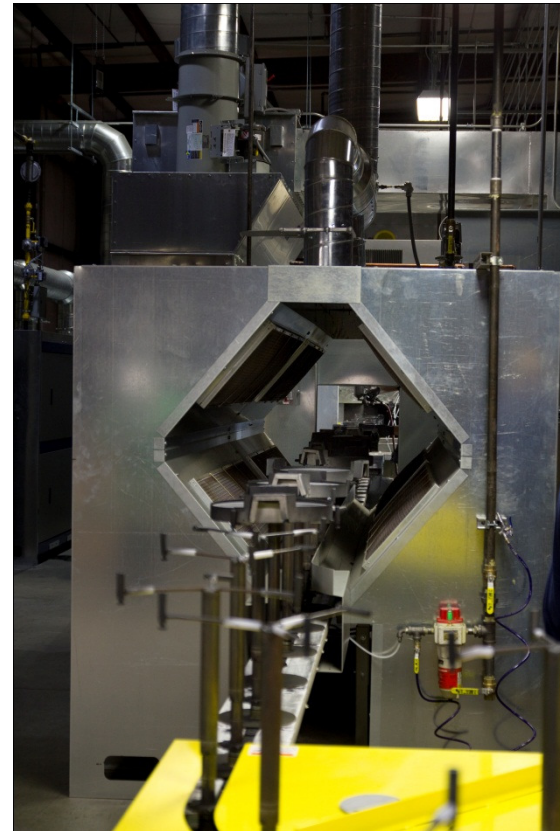
Properties of Thermolon™ Coatings

- High Emissivity
 - 0.92 vs a black body at 200 °C
 - Keeps underlying substrate cool for gas spreaders
 - Allows for faster cooking at lower temperature
- High Thermal conductivity 2.4 W/m/K
- Food-contact compliance
 - Certified by FDA & German lab to be food compliant
- Zero-PTFE and no PFOA
 - Water-based mineral coating



PI Capabilities

- 4+ years of development experience
- R&D lab with batch furnace for application development
- Thermolon coating line for cookware and small cross section parts
- Proprietary know-how in interfacing enamel/sol-gel coatings
- Experience working in cookware, OEM parts, industrial heat exchange
- Exclusive arrangement with Thermolon for US representation



Applications

Cookware

- Cookware – currently being sold for Al/SS cookware as part of the GreenPan brand in 50 countries

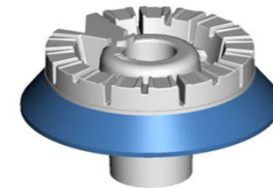


- PI has developed new technology to use it in conjunction with enamel for Cast Iron and Steel Substrates



Burners

- Clear or color coating for flame spreaders
 - Thermally stable to 840 °F / 450 °C
 - Easy to clean / non-stick
 - Prevents stains from food
 - High emissivity ensures cooktop does not get hot
 - Currently under test with OEM



Applications of Thermolon™

Other applications in test

- Non-stick oven interiors for ranges
- Heating elements for pools, water heaters, dish washers (prevent scale build up)



Future Work

- Testing continues in a number of applications
- In the long term Thermolon™ has the potential to become an effective disruptive technology replacing enamel and powder paint as a performance coating in a large number of industries such as
 - Power Industry
 - Appliances
 - Process Equipment

