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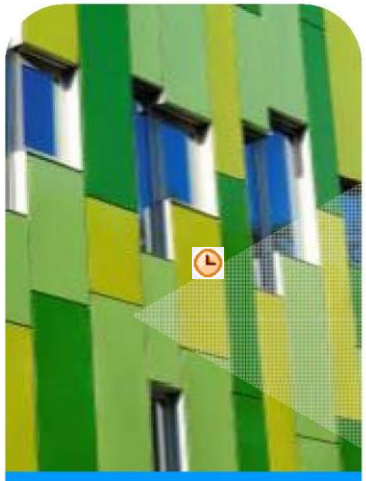
Huntsman Corporation

Five business divisions 15,000 associates, approx. $13bn revenues

Advanced Materials
Synthetic and formulated polymer systems

Performance Products
Intermediate chemistries and technologies



Pigments
TiO2 pigments, color pigments, functional additives and timber and water treatment

Polyurethanes
MDI-based polyurethanes

Textile Effects
Chemical & dye products

1 Based on 2Q14 LTM revenues

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Pigments

Naturals vs. Synthetics

An overview of their primary properties and how they relate to flowability and dosing

Don Abernathy - Huntsman Pigments and Additives
- ACERS Conference May 3, 2016

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Outline

- Pigments - Naturals vs. Synthetics
  - General Classification
  - Mining and or/ Manufacturing
  - Different Forms- powder, granules, liquids
  - Tint Strength
  - Color Space
  - Comparison

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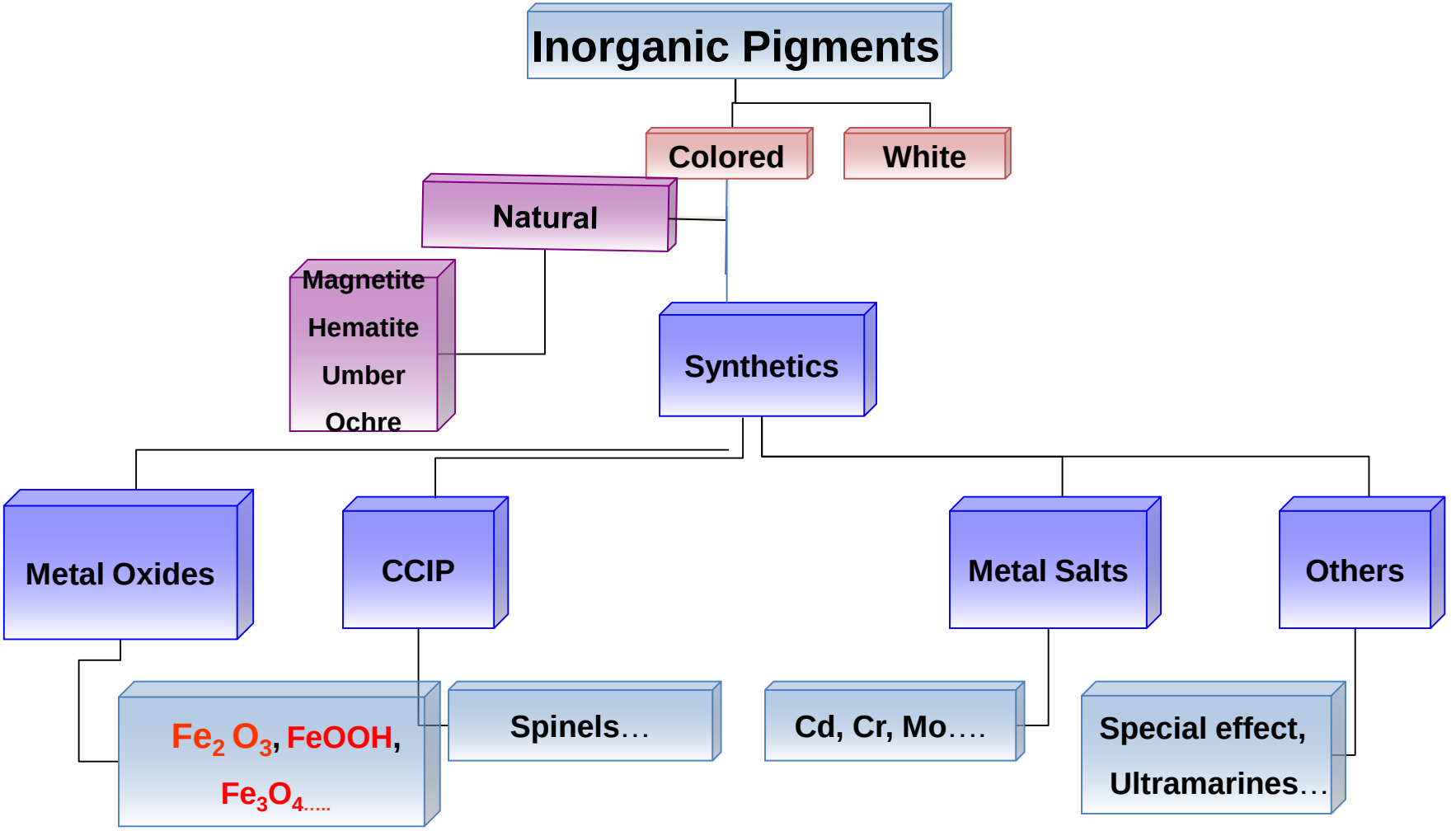
Classification



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Naturals

Naturals

- Red → Hematite
- Yellow → Hydrated iron Oxide
- Black → Magnetite
- Umbers

- Limited color space
- Generally ~½ the tint strength of synthetic iron oxides
- May contain 2 primary types of contaminates, but not limited to:
  - Non coloring contaminates:
    - Clays, sand, Calcium carbonate, Talc, ETC.
  - Coloring contaminates:
    - Magnetite, Manganese, umbers ETC.

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Mining of Naturals

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Different Naturals

- Generally supplied primarily as powder, or more recently in a granular form

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Synthetics

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Synthetics

- Broad color space palette
- Generally twice the tint strength of naturals
- Quality governed by an ASTM C979
- Does not contain contaminates
- Color space determined by size and shape of the individual crystal

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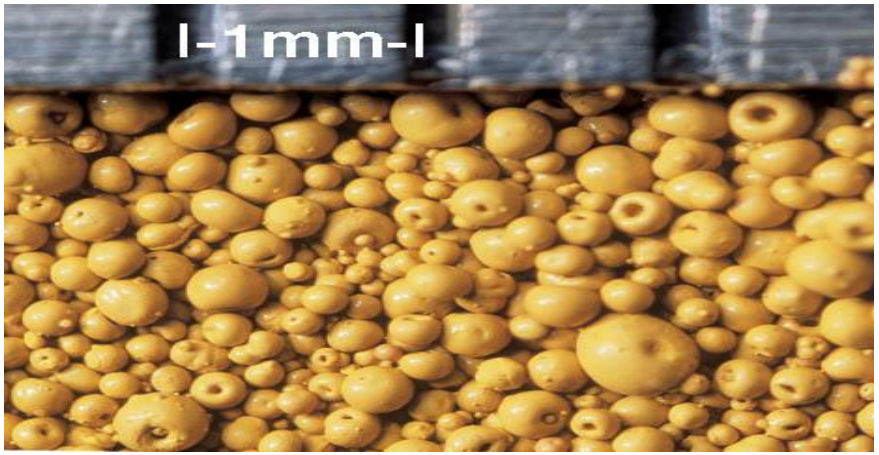
Different forms of Synthetic

- Commonly supplied as liquids, powders, or spray dried, built up or compacted granules



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Manufacturing of Synthetics

- Synthetic red iron oxide pigments were first produced in a laboratory setting in the 14th century.
- Originally referred to as “Mars Red” was followed by yellow shades in 1920’s.
- By modifying the manufacturing process of red and yellow, brown evolved.
- Various manufacturing methods include, but are not limited to:

Precipitation (“Cooking”)

Calcining (“Baking”)

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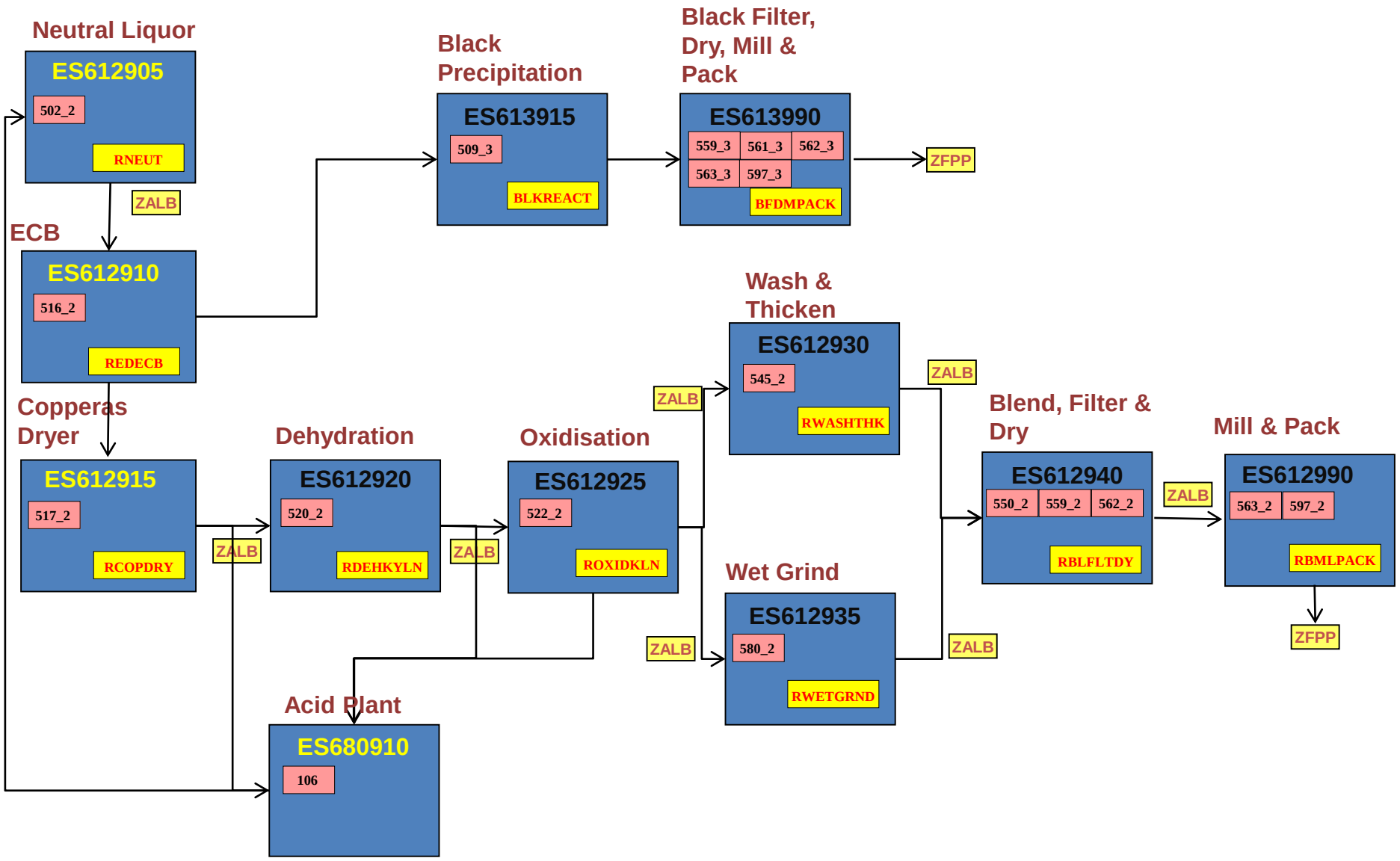
Synthetics can contain 60% recycled content

Synthetic I/ O Color Production

Red & Black – Streams



Properties: Particle Shape

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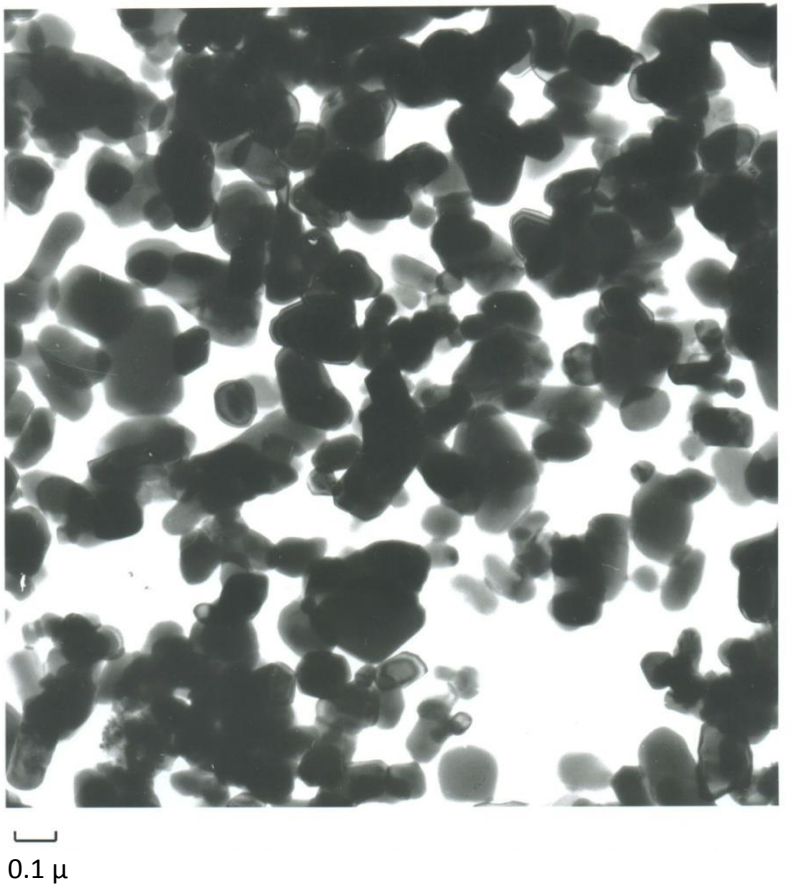
Yellow Iron Oxide
- FeOOH

Red Iron Oxide
α - Fe_2O_3

α



Microscopic images show differences in primary particle shapes – Yellows vs. Reds

Properties: Particle Shape

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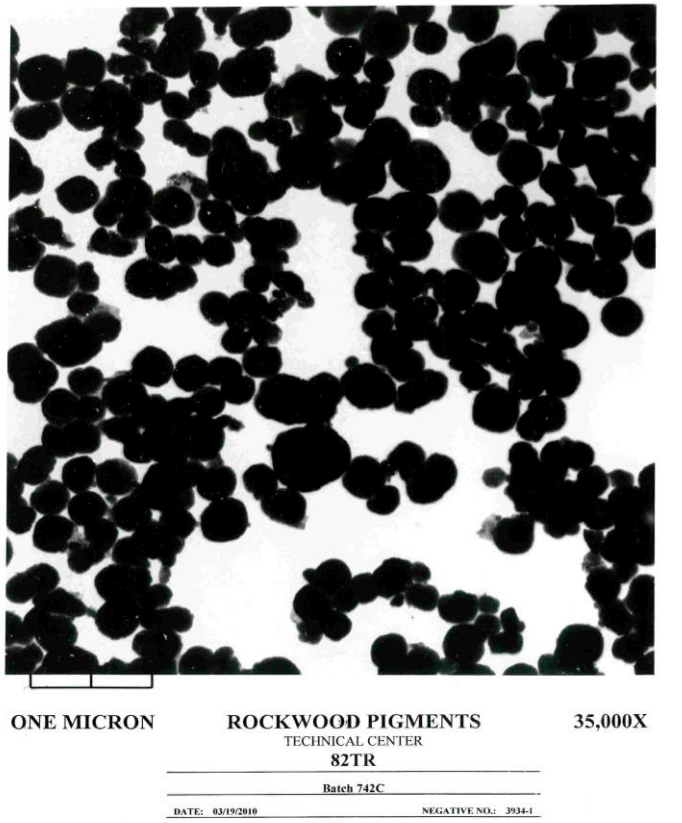
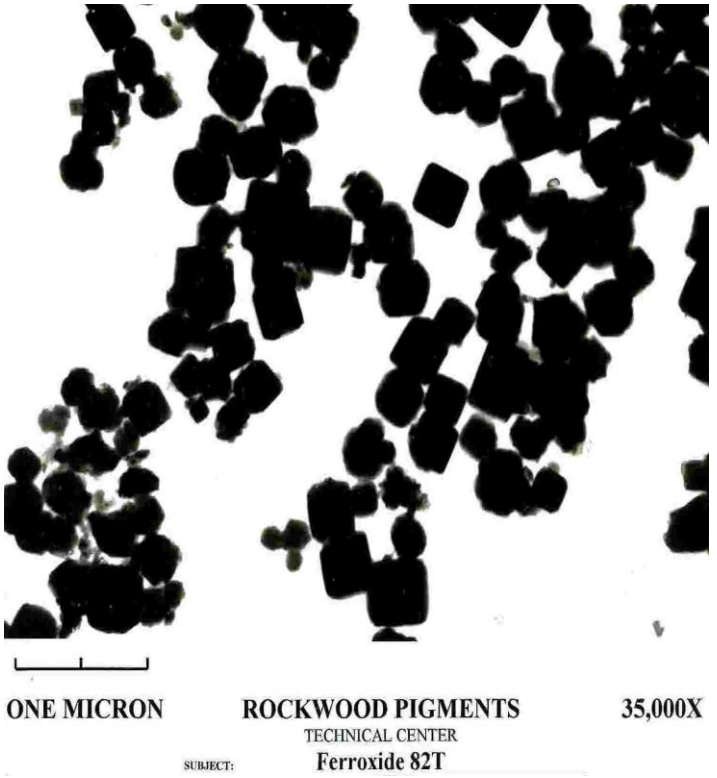
Black Iron Oxide
Spherical Fe_3O_4



Black Iron Oxide
Cubic Fe_3O_4



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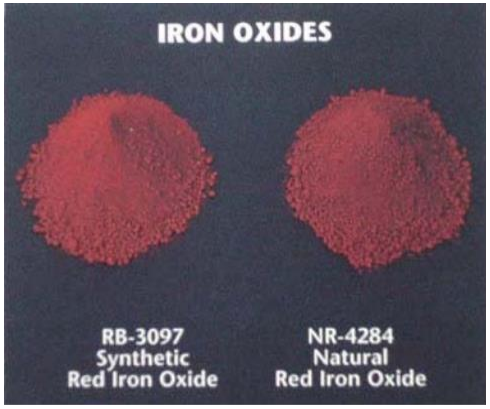
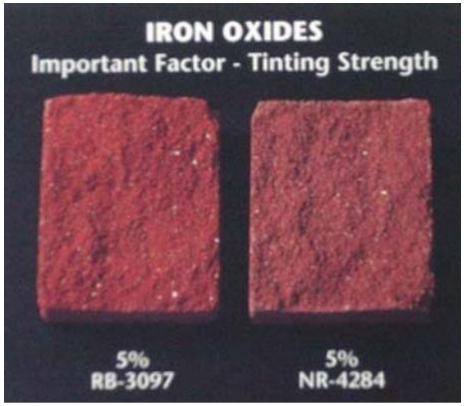
Synthetic vs. Natural iron Oxides





Synthetic Iron Oxides	Natural Iron Oxides
Manufactured, close color control	Ore deposits, variable by nature
Small particle size	Large particle size
Greater color power / unit of weight	Generally, lower tinting strength

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Primary Points of Comparison Synthetic vs. Natural

- Synthetic I/O properties are governed by ASTM C979.
- Color space of I/O is determined by the size / shape of the individual mineral crystal.
- Primary differences between synthetic and natural I/O:
  - Natural I/O often contain contaminates that reduce tinting strength.
  - Natural contaminates that impact color are Manganite, (MNO) that gives umbers their dark colored masstones.
  - Non-coloring contaminates are often natural extenders. (i.e.. clays, talk, and calcium carbonates.)

Don need to expand here to talk about color space, costs, revisit tinting strength, etc. This is your wrap up slide so go touch on all primary points above.

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Handling characteristics of I/O pigments

- Powders came first and are generally the most economical.
- Liquids evolved in an attempt improve housekeeping, metering and general handling.
- Granules were introduced in the late 1980's to address liquid shortcomings.
- Naturals (because of larger particles and contaminates) usually flow better than synthetics.
- Synthetic powders can absorb moisture leading to clumping / bridging. This inconsistent flow creates bottlenecks in some applications such as metering, dispensing or conveying.
- In most cases these bottlenecks can be resolved by equipment design changes or mechanical intervention.

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Conclusion

- Generally naturals I/O flow better than synthetics.
- Improved flowability in naturals can be attributed to particle size, purity, and type of contaminates, but this can adversely impact tinting strength and color performance.
- Synthetic handling is improved with introduction of mechanical and / or air intervention.
- To move synthetic iron oxides, steeper angles are required.
- Increased angle creates less restrictions / bridging and improves flow.
- Synthetics are a stronger colorant often by over 50%.
- Due to tinting strength superiority, synthetics require ~ ½ the dosage rate therefore require more accurate handling systems.
- Synthetic I/O have greater opacity which results in reduced visible production related color variations.
- Synthetics will give you a more consistent product.

Augusta Site Commissioning in Q1, 2016

- Huntsman is currently the only manufacturer of construction grade I/O pigments direct from the particle precipitation process in North America
- Augusta's capacity will be ~70M lbs. of capacity.
- Site represents investment of over $172M and will create over 100 employment opportunities.
- Warehousing and various blending locations will be spokes.

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Huntsman's Regional Warehousing

United States-

Beltsville, MD	**Atlanta, GA**	**Houston, TX**
Phoenix, AZ	**Denver, CO**	**Orlando, FL**
Seattle, WA	**Oakland, CA**	**LA, CA**

Canada-

Vancouver, BC	**Mississauga, ON**

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Thank You

Any Questions?