The Basics of Investment Casting Wax

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Investment Casting Wax

- Wax is the oldest thermoplastic material known to man
- Beeswax was utilized in the lost wax process by craftsmen in the ancient civilizations of China & Egypt
- Today the name ‘wax’ applies to any substance having wax-like properties
  - better described as industrial moulding compounds
- If the pattern is wrong, the casting will be wrong
- it follows that the choice of wax is critical

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Modern Investment Casting Wax

- Modern blends are complex compounds containing numerous components
  - hydrocarbon wax
  - natural ester wax
  - synthetic wax
  - natural resins
  - synthetic resins
  - organic filler materials
  - water

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Structure of Investment Casting Wax

- Many variations are formulated to suit differing requirements
- Key properties such as melting point, hardness, viscosity, expansion and contraction, setting rate, etc are all influenced by the structure and composition of the wax compound
- Understanding the properties of the individual components and how they interact is essential in meeting foundries individual requirements
- The complex composition manifests itself in a physical behaviour different to that of other substances

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Expansion & Contraction of Wax

- The structure and components used in an investment casting wax will influence the expansion and contraction
- Like other materials wax expands on heating and contracts on cooling
- In comparison with a metal the expansion is relatively high
- Wax expansion and contraction rates are not uniform but vary with phase and structure changes during heating/cooling

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Phase Changes of a Typical Wax

- Unlike other homogeneous chemical compounds, wax does not melt immediately on heating but passes through several intermediate states :

solid → plastic → semi-plastic → semi-liquid → liquid

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Categorization of Investment Casting Wax

- Pattern wax
  - straight (unfilled)
  - emulsified
  - filled
- Runner wax
- Reclaim & Reconstituted wax
- Water Soluble wax
- other Special wax
  - dipping/patching/adhesive

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Straight (Unfilled) Pattern Wax

- Complex compound of many wax and resin components
- Surface finish normally shiny
- Can usually be reclaimed and reconstituted for use on both runner systems and patterns

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Emulsified Pattern Wax

- Base materials compatible with emulsifying agents and water
- Emulsified with 7 - 12% water
  - water acts partially as a filler and reduces cavitation
- Surface finish normally smooth
- Can usually be reclaimed and reconstituted for use on both runner systems and patterns

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Filled Pattern Wax

- Base materials are filler compatible
- Blended with a powdered, inert filler material insoluble in the base wax
- Filler gives the wax greater stability and less cavitation
  - organic filler material with fine particle size is essential to ensure complete burnout
- With advanced reclaim technology can usually be reclaimed and reconstituted for use on both runner systems and patterns

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Specialist Wax

- Compounds used to help the production of finished wax patterns ready for assembly
  - soft repair wax
  - hard repair wax
  - adhesive wax
  - dip seal wax
  - rod wax
  - water soluble wax

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Reclaim & Reconstituted Wax

- Customers scrap wax returned to Blayson for reprocessing
  - cleaned & filtered
  - additives to adjust properties to specification
- Reclaim wax for runner systems
- Reconstituted wax for pattern production
  - Reconstituted Filled Wax
  - Reconstituted Emulsified Wax
  - Reconstituted Straight (Unfilled) Wax
- Environmental and economic benefits

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Properties of Investment Casting Wax

- The majority of investment casting wax materials are complex compounds of numerous components
  - each included to influence the final properties
- Wax properties are of critical importance to foundries for the production of good castings
- Once a specification has been agreed it is essential that compliance with the limits is maintained
  - supported by process and quality control

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Quality Control

- Important for both wax manufacturer and foundry to monitor wax properties
- Strict quality control procedures are essential
- Ensures consistency and compliance with specifications
- BICTA recommended tests :
  - melting (drop) point
  - congealing point
  - ash content
  - penetration
  - viscosity

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Summary

- Investment casting wax compounds are complex
  - consist of many different components
  - consequently exhibit a range of properties
- Wax properties influence pattern behaviour in the foundry and ultimately the quality of castings produced
- Correct product choice allied with strict process & quality control procedures is essential

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