

Investment Casting Wax Technology Through Time

ISIC 2019

Agenda

- Introduction
- Brief history of wax
- Early wax materials
- The need for wax development
- Modern wax materials
- Critical demands of wax today
- Future wax developments

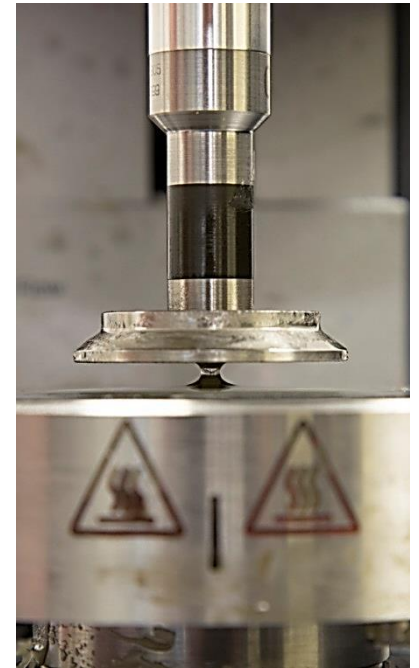
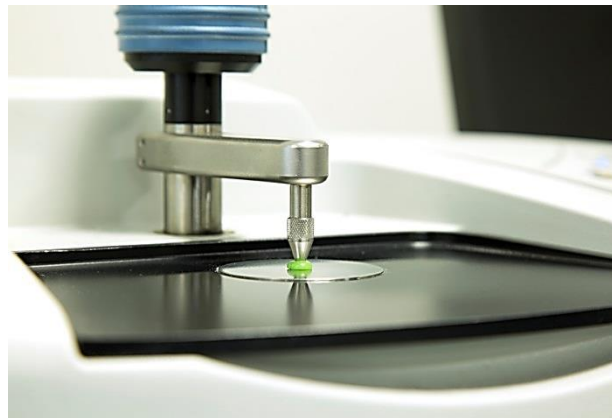
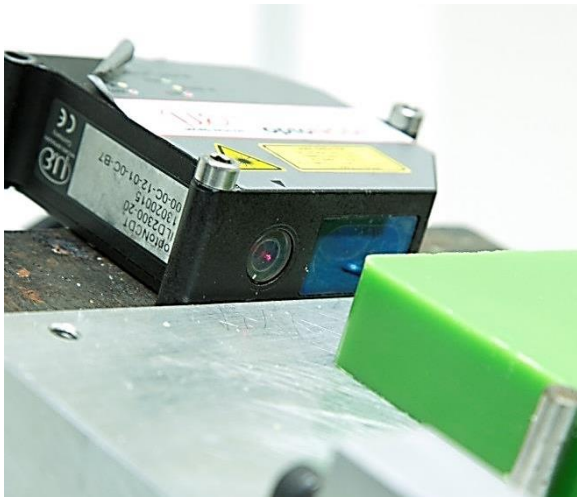
Blayson Technical Centres

- Group Technical Centre in Cambridge UK
- Further Technical Centre in Chiba Japan
- Quality control of incoming raw materials and finished wax products is key
- Providing the investment casting industry with centres of excellence for wax technology and research and development



Blayson Technical Centres

- Focus on wax testing and research and development
- Full wax injection facilities
- DSC and TMA testing
- Process related testing methods
- Continuous wax testing improvements



Brief History of 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



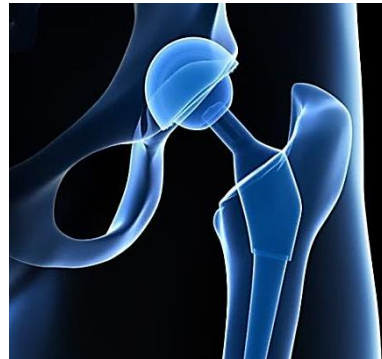
Early Wax Materials

- In order to make patterns for early moulds many types of materials were used
- These materials included beeswax, tallow, resin, tar
- Though suitable for castings at the time, these would be unsuitable for the demands of modern manufacture



The Need for Wax Development

- The demands of modern industry required more sophisticated wax materials offering improved batch to batch repeatability
- Leading to the development of the wax materials today
- These materials are designed to be dimensionally stable
- Capable of producing a range of wax patterns
- Stable composition to allow recycling



Modern Wax Materials

Modern wax is made up of materials such as

- Paraffin wax
- Microcrystalline wax
- Natural wax
- Resins
- Polymers
- Fillers



Modern Wax Materials

- Many variations are formulated to suit differing requirements
- Key properties such as melting point, hardness, viscosity, expansion and contraction, setting rate are all influenced by the structure and composition of the wax compound
- The complex composition affects the physical behaviour on injection and solidification
- Knowledge of the properties of the individual components and how they interact is essential in understanding the behaviour of wax during the investment casting process

Critical Demands of Wax Today

- Today's castings are extremely complex
- Complex requirements not only for aerospace but also IGT, medical and other castings
- The industry demands wax capable of producing thin walled sections, trailing edges, use of ceramic cores, large sections, compatible with improved recycling techniques
- Wax formulations have moved forward in order to meet these critical needs of the industry
- Wax testing is required to keep pace with these demands to provide batch to batch repeatability and a stable product
- Advanced control is used not only on virgin wax but also reconstituted and reclaimed wax materials

Future Wax Developments

- The demands on the investment casting industry and wax requirements are constantly under review
- Development is ongoing in areas including the following
 - Wax suitable for reforming of patterns after injection
 - Wax materials capable of improving cycle times
 - Wax for thin walled sections
 - Development of filled compounds

Future Wax Developments

Wax suitable for reforming of patterns after injection

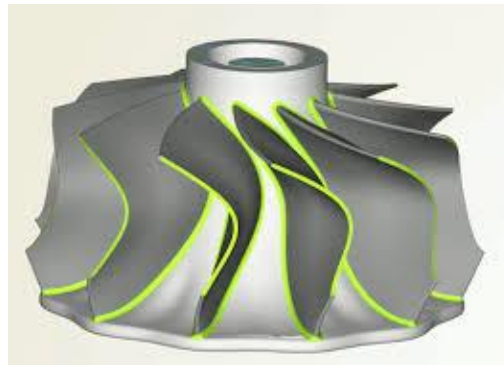
- Wax materials are made up of a series of short and long chain molecules
- When a wax pattern is reformed, after it is removed from the reformer the wax molecules will attempt to recover to their previous shape
- This process is referred to as wax memory and has led to research into materials to resist this process



Future Wax Developments

Wax materials capable of improving cycle times

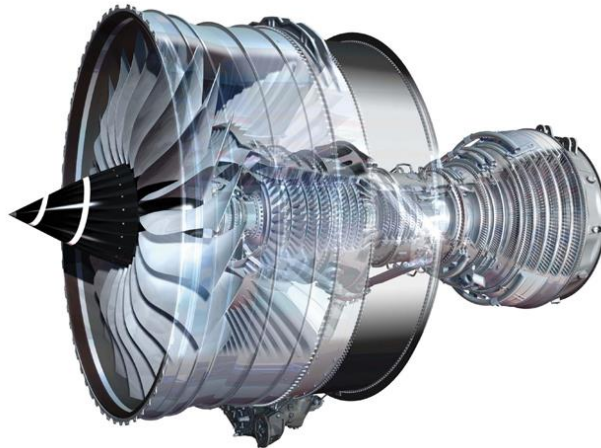
- For high volume production of wax patterns cycle times are critical
- Development of a fast cycle time wax capable of producing high volume of wax patterns
- A reduction of even 2 seconds in cycle time can provide major overall cost savings
- With a typical 25 second cycle time even a 1 second reduction can result in a 4 % increase in output



Future Wax Developments

Wax for thin walled sections

- There is an growing trend for increased efficiency through weight reduction
- This has required the development of wax materials capable of producing extremely thin walled sections



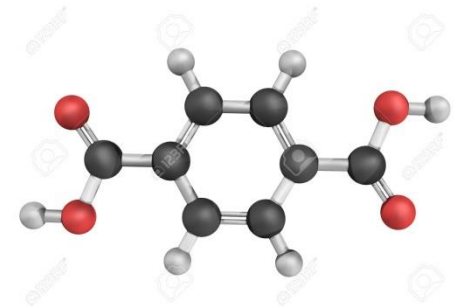
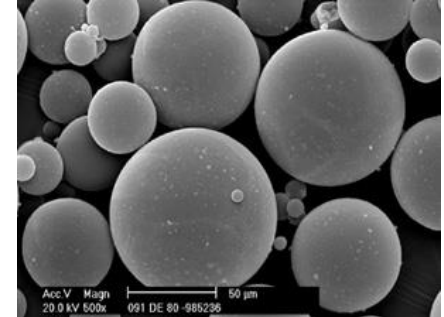
Future Wax Developments

A large percentage of wax materials used are filled

Types of filler used include -

- XLPS – Generally around 30%
- Acid filler – Tends to be used on reactive materials such as Titanium

Development of unfilled wax materials is underway with properties comparable to filled wax



Summary

- This paper has reviewed a brief wax history
- Wax formulations have moved forward in order to meet the critical needs of the industry
- Advanced control is now used not only on virgin wax but also reconstituted and reclaimed wax materials
- The type of wax used is historically selected depending on the current fixed process
- Innovative materials offer exciting new opportunities
- Essential to maintain close technical partnership between foundry and supplier

This paper is available from
www.investmentcastingwax.com

Thank You

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