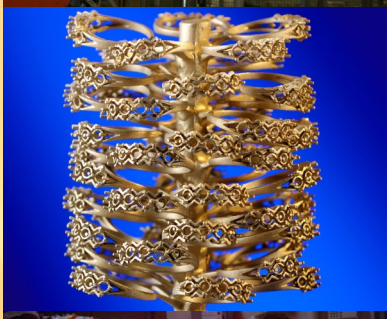
Ransom & Randolph

JUL-AUG
2019

Casting Connection



R&R Expands Jewelry Line

R&R has secured the formulation and manufacturing rights for the former Satin Cast™ family of jewelry investments from Allied Mineral Products.

Adding these brands to the R&R premium jewelry investment family allows R&R to continue providing casters with the most revered product lines in the industry – supported by the strongest technical team.

“We are excited to manufacture the SC20 formulations at our Maumee, Ohio facility where our iconic Ultra-Vest® investment is made. Dedicated to providing the highest quality investments, our products continue to be Made in the USA with superior US-sourced raw materials,” says Daniel Nixon, Vice President.

R&R will maintain the unique SC20, KC2000, SC-D, SC-X and SV20 formulations and raw materials that have been embraced by the global jewelry casting market for nearly 50 years, supplying them from its Maumee, Ohio manufacturing facility.

Interested in more details?
Contact: Scott Todd, Global Sales Manager
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Inside this issue

How Process Variables Impact Investment Removal Properties

Santa Fe Symposium 2019

An excerpt from:
Stover (2019) *How Process Variables Impact Investment Properties*. Maumee, OH: Ransom & Randolph.

To request a complete copy of this technical paper, please email R&R at:
RR-Marketing@dentsply.com

Introduction

An investment is comprised of binder, refractories, controlling chemicals (used to control fluidity and working time) and various proprietary ingredients. Gypsum functions as the binding agent, which gives the system strength and provides insulating properties. When we heat gypsum it shrinks. Cristobalite, combined with a secondary refractory of raw quartz, counteracts gypsum shrinkage and creates positive thermal expansion through the burnout cycle.

Quenching is defined as the removal of investment using water. During quench, the mold temperature is aggressively reduced, causing the investment to contract, quickly moving the investment from positive expansion through negative shrinkage. The energy created by thermal shock overcomes the binding mechanism of the gypsum component.

Ideally, the investment falls away from the casting detail without additional effort. A poor quench can cause processing delays and increased labor costs. Possible damage to finished pieces may occur if additional manipulation is necessary to remove investment.

"While investment formulation can play a role in the quench process, other controllable process variables have a statistically significant impact on quench."

While investment formulation can play a role in the quench process, other controllable process variables have a statistically significant impact on quench. This paper examines how these process factors affect quench.

Quench Determination—Procedure Development

The quench process is historically measured in a subjective manner. As molds are cast and quenched, an experienced caster typically determines visually if the quench is "good" or "bad." For this paper, it was important to measure the quench objectively. In order to do this, we needed to understand and control certain constraints in the process. In addition, we needed to collect quantifiable data that allowed us to measure and compare the degree or difference in quench as certain process variables were purposely changed.

Previous attempts to quantify quench considered the subjective visual measurements. This included measuring openings and holes on the top of molds and counting the number of "open" perforated holes on the flask. In order to truly evaluate quench, we developed a casting procedure that controlled as many process and environmental variables as possible to eliminate the impact they may have while capturing quantifiable weight data for comparison.

Once we standardized the casting process, actual mold weights were captured at each stage of the process, eliminating visual subjectivity.

Every effort was made to collect all investment material that did not initially remove in water. While large, flat surfaces are not highly detailed, residual investment was always trapped between the plates.

Experiment Design

To understand what process variables affected quench, a design of experiment (DOE) was created. DOEs determine the relationship between factors affecting a process (cause) and the output of that process (effects). The input process variables are changed to determine the effect on the resulting output variable; in this case, investment removal.

For this paper, we considered the following.

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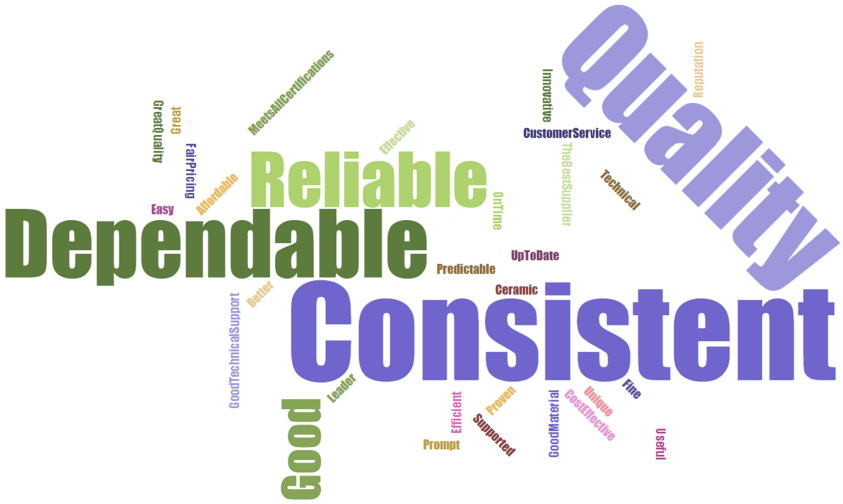
R&R Report Card

Earlier this year, in an effort to help us provide products and services that continue to meet your needs, we asked you to complete a customer satisfaction survey.

Thank you for taking the time to share your thoughts! Here is what you had to say about us.

What three words would you use to best describe R&R products?



On average, R&R received the following ratings to the following questions:

How well do R&R products meet your needs?
Extremely well

How would you rate R&R for customer service/order placement?
Excellent

How responsive has R&R been to your technical questions/concerns with regards to our products?
Extremely Responsive

How responsive has R&R been to your technical questions/concerns with regards to process issues in your foundry?
Extremely Responsive

How would you rate the usefulness of our technical support?
Above Average

How likely are you to purchase from R&R again?
Extremely Likely

Overall, how satisfied are you with R&R?
Extremely Satisfied

On a scale of 1 through 10 (1=not at all likely; 10=extremely likely), how likely is it that you would recommend R&R to another caster?
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R&R Annual Service Awards

The following R&R employees were honored in June 2019 at our Annual Service Awards Luncheon:

30 Years
- Gene Braun
- Terry Gutierrez

25 Years
- Mickey Pantoja

20 Years
- Dave Berta

15 Years
- Paul Roudebush

10 Years
- Dave Lawrence

5 Years
- Jeff Bohnert
- Tori Powell
- Alisa Rawski

Retirees
- Diane LaMetterey (9 years of service)
- Denise Harrold (31 years of service)

Their efforts and dedication play a tremendous part in our success and we appreciate their commitment!

Please join us in celebrating their many years of service to R&R!

Battling Burn-In

Burn-in presents as a grainy surface, often with black stains. This defect indicates that the mold and metal were overheated, causing a metal mold reaction resulting in oxides and silicates covering the mold. The causes of this defect are evident in the shell and metal portions of the process. To cure these causes, R&R recommends taking the following actions:

Shell Cause: Refractory choice for primary coats is not suitable for the amount of heat exposure during pouring or compatible with types of alloy cast (low grade refractories).
Cure: Use a high quality refractory for your primary coats, increase the zircon refractory percentage used for primary coats (100% zircon primes).

Metal Cause: High metal and mold temperature at casting.
Cure: Improve temperature management during preheat and pouring, avoiding heat concentrations. Increase the rate at which the mold is cooled to reduce the likelihood of mold degradation.

Struggling with burn-in or other defects in your foundry?
Contact our technical team at: RR-Technical@dentsply.com today!

Karen Maguire
Customer Service Supervisor

Welcome Karen!

We are pleased to announce Karen Maguire's appointment as Customer Service Supervisor.

In this position, Karen will be responsible for the Customer Service team, ensuring customer service excellence from order-taking through delivery.

Karen joins the R&R team with an extensive background in customer service management. She previously worked for Owens Illinois Inc., as a Pricing Operations Analyst and Customer Service Manager/Regulatory Coordinator.

"I am proud to announce the appointment of Karen Maguire as our new Customer Service Supervisor," said Scott Todd, R&R Global Sales Manager. "We are confident Karen's expertise will help further raise R&R's service capabilities for our customers."

Karen received her Bachelor's degree from The University of Toledo and has completed Green Belt and APICS coursework. She is also an ASQ-Certified Quality Technician.

Karen can be reached at:
- Karen.Maguire@dentsply.com
- 419.794.1212

Please join us in welcoming Karen to the R&R team!

Contact the Author

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Process Variables

•*continued from page 2*•

Input Variables

- Metal Temperatures
- Mold Temperatures
- Water-to-Powder Ratio
- Quench Time
- Quench Water Temperature
- Number of Castings Per Tree

Two separate DOEs were required to properly measure these impact variables' impact on quenchability.

DOE 1 Setup & Results

For DOE 1, a general factorial DOE was created utilizing two controlled input variables to analyze the effect on the output variable. For this experiment, the focus was mold and metal temperatures at three levels, using the standard casting method and then evaluating quench. All other process input variables were held constant in DOE 1 to isolate the significance of mold and metal temperatures.

Conclusions we can make from DOE 1:

- Mold temperature has a significant impact on quench. The higher the temperature, the more quench results improve.
- Metal temperature changes over the range selected (1010-1038°C/1850-1900°F) do not impact quench results.

DOE 2 Setup & Results

For DOE 2, an optimal factorial DOE was created, utilizing four controlled input variables (quench time, quench water temperature, water-to-powder ratio and number of plates), to analyze the effect on the output variable (quench). Metal temperature was held constant at 1900°F and mold temperatures were held at 900°F.

Conclusions we can make from DOE 2:

- Time (after pour or before quench) has a significant impact on quench.
- Water temperature is a statistically significant factor in how a mold quenches.
- An increase or decrease in water-to-powder ratio does not impact investment removal properties.
- Quench was not impacted by changing the number of plates, spacing between plates, or casting weight difference of 48%.

Summary

A mold temperature shift of only 55°C (100°F) was enough to impact quench results. At a mold temperature of 900°F, only 10% of the investment was retained after quench. At 800°F, 40% was retained, four times as much.

10% Retention

40% Retention

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Process Variables

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The lower the mold temperature at quench, the higher the amount of investment retained in our molds. Controlling temperature in this process could have significant time saving implications.

Time (after pour or before quench) has a significant impact on quench. The percent of investment retained increases from 10% at 10 minutes to 60% at 30 minutes.

Flask Retaining 60% of Investment

This is most likely due to the shorter wait times before quench and higher mold temperatures. The thermal shock energy is increased with a mold quenched at a higher temperature because we have reduced the amount of cooling based on time.

Water temperature is a statistically significant factor in how a mold quenches. The percent retained decreases from 35% with a water bath temperature of 10°C (50°F) to 20% with a temperature of 32°C (90°F). The higher the temperature of the water bath, the better the quench.

While this study showed what process factors played a significant role in the quench of a cast mold, it also showed those that are not significant. Metal temperature, casting weight and water-to powder ratio had no impact on quenchability.

To request a complete copy of this technical paper, please email R&R at: RR-Marketing@dentsply.com

Need to Place an Order?

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Ransom & Randolph

At R&R, *Investing with Innovation™* is more than just a slogan, it's a way of life. Dedicated to advancing the investment casting industry, we take pride in providing foundries with extensive process knowledge, exceptional technical expertise and innovative product technology. By coupling our revolutionary product developments with our experienced staff, manufacturing and warehousing facilities, we successfully help you become a casting industry leader. R&R is a wholly owned subsidiary of Dentsply Sirona (NASDAQ: XRAY).

R&R's core businesses are comprised of ceramic shell, industrial mold, jewelry and dental investment casting.

R&R takes great pride in providing customers with a pleasant procurement experience. R&R's Maumee, Ohio based customer service team services North America and US export customers. Our UK-based agent, HTM Tradeco, Ltd., provides service for the European Union. From initial order placement through delivery, R&R's customer service team takes responsibility for accurate and efficient processing of your material needs. As a result, R&R's customer service team is unmatched in the industry.

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