GRINDING WHEEL DIVISION

1978 Product Development Period Report

PLAINTIFF'S EXHIBIT

CGI-17

Project Number: E200-5

Title: General Diamond and Borazon

Objective: Develop improved bonds, manufacturing processes, and second sources; investigate new materials and replace those which may be in short supply or adversely affect the product.

Period:

1. Two 3" thick (1BN320-Q100-B4) Borazon wheels were successfully made and shipped to the customer. Again, four wheels were made to get two good wheels. One wheel was scrapped because of circular cracks; the other was scrapped because of flaws in the core causing cracks in the core. A modification was made to the core of one of the 320 grit to improve core strength and manufacturability (see below for reasons). The grit size of the core was changed from 600 to 220. The change created additional strength and density in the core. The 220 grit core was also less out-of-balance as compared to the 600 grit core. A comparison of the cores will be forthcoming.

   The two 3" thick (1BN600-Q75-B4) Borazon wheels which were sent to the customer last period were partially successful. The grinding results were excellent. Grinding ratio was extremely high with finish being within acceptable limits. The problem which eventually caused removal of the wheels was cracks which propagated from the rim through the core to the ID of the wheel. This problem precipitated the core modifications described above. The 600 grit wheels are being shipped back to the lab for examination. New wheels will be made to replace the cracked wheels.

   A high production mold has been manufactured for trial at Recto Molded Products. This 6 x ¼ type 1A1 mold will produce aluminoid cores for use by the Diamond Room if successful. Trials will be completed next period.

   Production Bakelite cores were produced using Plenco 552 molding resin instead of standard Plenco 397 for field tests. The Diamond Room had difficulty in molding the cores due to the increased bulk fill factor of the Plenco 552. More Plenco 552 with a greater apparent density has been received to continue the trials.

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2. The two 3" thick 1BN320-Q100-B4 Borazon wheels are operating in the customer's plant. Initial problems of burning were overcome but problems in dressing are still occurring. The new tooling to manufacture 3" wheels without tamping is still on order. Several experiments were performed to add knowledge in the manufacture of these wheels. Several small laminated bars were made using the 1BN600-Q-75-B4 rim mix with different core materials. The resultant warpage was measured to determine relative thermal expansions. The 220 grit abrasive-filled core and the steeloid core exhibited the closest thermal expansion to the rim mix. Further experiments with the machinable steeloid core are planned. A rim (Q125 dummy) was molded to a vitrified core. This trial was to see the effects of a zero-expansion core on the rim. The resultant rim and core cracked during molding. No further work is scheduled using a vitrified core.

   Trials using the high production design preform mold at Recto Molded Products were successful. The preforms passed burst speed tests, balance tests, and rim adhesion tests. As a result, an order for 100 6 x ¼ preforms was entered and filled. So far, no quality problems have arisen from these cores. Orders have been entered for 1/8", 1/2", 5/8", and 3/4". These preforms should help relieve some of the problems with late orders in the Diamond Room. A 3-3/4" 11V9 high production mold is currently being made.

   Three orders for Bakelite core, 11V9 and 12V9 wheels, were supplied with Plenco 552 instead of standard 552. The molding problems were solved and good cores can be produced. These wheels will be followed in the field for any quality problems.

3. 3" Thick Borazon Wheels

   The two 3" thick 1BN320-Q100-B4 Borazon wheels continue to perform at the customer's plant. The wheels were evaluated on two applications; one successful and one not. More wheel orders are expected for this grade of wheel for the successful application. The new tooling to facilitate the manufacture of these wheels has been received. Three dummy rims have been molded on cores utilizing the new equipment. Evaluation and development of new pressing techniques with the new equipment is almost complete. The new equipment evaluation has delayed full evaluation of steeloid cores. Orders for three different wheel grades are expected soon. These wheels should be shipped next period.

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Recto Molded Products
Approximately sixty (60) wheels using 6 x ¼ cores made by Recto have been made with only three wheels being out of balance. The orders for 6 x ½" and 6 x 5/8" were filled but balance and out-of-parallel problems have limited the use of these thicker preforms. Both Recto and I are working to resolve these problems immediately. The problem seems to be equipment related though it hasn't been pinpointed.

The mold for 3-3/4 11V9 cup wheels was evaluated and approved. An order of 100 was received. Some of the cores were undersized in overall thickness, but a weight increase per preform was made to increase the average overall thickness. This core has been approved for use by the Diamond Room. 5" 11V9 mold equipment has been designed and is on order along with back-up equipment for the 6" 1A1 mold.

Thick Borazon Wheels
Two 3" thick 1BN600-Q75-B4 were sent to the customer for evaluation in parallel with the 1BN320-Q100-B4 currently operating. Initial results of the evaluation are encouraging. Additional wheel orders for both grades are expected momentarily for full evaluation of Borazon. A new grade for the application which the 320 grit wheel was unsuccessful has been made (1BN220-S100-B4-969). Evaluation of the wheels can begin as soon as the order is entered and the wheels are shipped.

Recto Molded Products
All the out-of-balance and out-of-parallel problems have been solved. Recto is currently on-stream providing all 6" preforms up to 5/8" thick and all 3-3/4 11V9 cup wheels. A considerable increase in pressing capacity should be realized by using these cores.

Plenco 552 Evaluation
The 11V9 and 12V9 cores produced with Plenco 552 worked in the field tests with no problems. In an effort to reduce the amount of asbestos fibers in the plant, Plenco 552 will replace 397 as the standard Bakelite core material.

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5. 3" Thick Borazon Wheels

The customer had a wreck on the machine and destroyed the two 1BN600-Q75-B4 before full evaluation was completed. The two 1BN320-Q100-B4 wheels continue to operate though a small problem has occurred. The customer has noticed operating changes during the life of the wheel between dressings. The customer doesn't like to dress the wheels. New grades have been suggested for both applications to help eliminate the problems they have been experiencing.

Recto Molded Products

The 5" 11V9 mold has been delivered to Recto for trials. Some mold deterioration has occurred in the 3-3/4" 11V9 mold that they have. Engineering is looking into the problems and deciding what should be done.

3" Thick Borazon Wheels

The customer continues to use the two 1BN320-Q100-B4 wheels. They have been in use for 5 months now. The customer has ordered 6 wheels - 2 each of 3 grades - for testing. The wheels should be produced and sent to the customer next period.

Recto Molded Products

The cores from the 5" 11V9 mold have been approved for use. Quality problems on some of the cores have arisen. Both Engineering and the Lab are looking into ways to eliminate these problems.

7. 3" Thick Borazon Wheels

The customer continues to use the two 1BN320-Q100-B4 wheels. Two 1BN280-Q100-B4-982 wheels have been made for customer evaluation. The wheels are scheduled to be shipped on 7/10/78. Two 1BN280-Q100-B4-982 wheels and two 1BN400-Q100-B4-981 wheels are being manufactured for customer trials.

8. 3" Thick Borazon Wheels

Two 1BN280-Q100-B4-982 and two 1BN400-Q100-B4-981 wheels were shipped on 7/25/78 to the customer. The wheels were made with new mold equipment which greatly facilitated manufacture. The output was doubled from 1 wheel/day to 2 wheels/day.

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Recto Molded Products

Due to recent severe quality problems with the cores being received from Recto, all orders have been cancelled. The core production will create capacity problems with our presses. To alleviate this problem, the lab is developing a faster core manufacturing process utilizing a constant platen temperature process and outside-the-press cooling. I am also contacting all of the custom molders in the area to see if anyone is interested. So far, Kurz-Kasch, Inc. of Dayton has shown a great deal of interest. A series of trials at the compression molding plant in Wilmington are scheduled for 8/8/78.

9. 3" Thick Borazon Wheels

The two 1BN400-Q100-B4-981 wheels which were made and shipped last period cracked during transport to the customer. The cracks seemed to be like the axial ones experienced during the initial stages of development of the fine grit-high concentration wheels. Since the wheels went through finishing without cracks, they must be on the fine edge of stress. A lower concentration or softer wheel should eliminate this cracking problem. The two grades of 280 grit roughing wheels are not giving the expected results. All indications point to hardness of the wheels as being the problem. The customer is making good parts but is not happy with the grind. The wheels are not performing as well as the 1BN320-Q100-B4 wheels which have been operating since February.

Perform Manufacture

The trials at Kurz-Kasch were successful. They produced 80 cores (6 of the 80 were undersized and unusable) which have been used for orders. No problems were experienced with these cores. The price quoted for a 1000 core order was $7.75 per core (quite an increase from Recto at $1.98/core). The price is too high to consider them a source for cores.

Lifetime Carbide

Sixteen wheels were sent to Lifetime Carbide in Colton, Oregon. There were four wheels, each of 4 different grades under lab code numbers. One grade worked exceptionally well, doubling the average life of the competitor's wheels. A 50 wheel order for a grade check was supposedly entered. Joe Mitchell said that a good share of this account should be ours due to the performance of the CMD100-V30-B106 wheels which were so successful.

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10. 3" Thick Borazon Wheels

An attempt to produce two 1BN400-W-B7-128 wheels resulted in numerous residual stress cracks appearing in the rim section. Even though one wheel was cooled to room temperature before stripping, it cracked while sitting on the desk. The concentration was reduced to 72.5 (the same as the former 600 grit honing wheels) to simplify manufacture. So far, the two wheels which were made have not cracked. In subsequent discussions with G.E. personnel, the only difference between the 320 and the 400 grit sizes is the particle size distribution. Experiments will be performed to determine if this parameter is the culprit causing cracks.

At the suggestion of Paul Soden, the customer slowed the RPM of the 280 grit wheels to soften the action of the wheels. The results were rather dramatic. The quality of the parts improved at the same production rate. It is too early to tell if the G-ratio is going to be acceptable, but so far, little compensation has been made on the wheels. The customer is pleased with the action of the wheels.

Lifetime Carbide

An 84 wheel order from Lifetime Carbide was entered for the CMD100-V30-B106 wheels. This is the first large order for a single wheel grade from them. I hope it is an indication of a significant portion of their business.

ABN 360 Evaluation

The first trials of ABN360 (DeBeers Borazon) were run at Wilserv in Batavia. Harold Willey liked the ABN360 better than G.E. Borazon and asked to order it for his Borazon wheels. Tests to quantify if there is a difference between the two Borazon suppliers are being scheduled.

11. 3" Thick Borazon Wheels

There is nothing to report except bad news this period. The effects of slowing the wheels was only temporary. After 5 days of operation, the quality of the parts deteriorated and same problems surfaced again.

Two 1BN400-Q75-B4 wheels were shipped to the customer for evaluation. During the grooving operation, some rim separation was experienced. The grooving is going to be completed and the wheel will be speed tested and sent back to the customer. If the wheel doesn't pass the speed test, a new wheel will be sent to them.

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12. The rim separation problem was discovered to be related to a build-up of mold release on the top and bottom plates of the mold. The rim adhesion is excellent after cleaning the mold release off, but a serious cracking problem has developed. Several process variables have been changed to reduce the cracks but, so far, nothing has worked. Some new ideas are in the offing and will be tried as soon as possible.

13. 3" Thick Borazon Wheel

Several process variables were changed to solve the cracking problem, but no improvements were made. After consulting with the customer and lab feasibility trials, it was decided to provide the 3" thick wheel in 3-1" sections on abrasive-filled core. The first wheel sections have been made with no problems. The second wheel sections were made by Diamond Room personnel. These sections will be epoxied together on a two-piece aluminoid bushing. The wheels will be shipped the first of next period.

10 x 2 One-Piece Wheel

A 10 x 2 one-piece wheel was molded this period. The wheel was molded with the use of a heater bond to melt the center of the wheel first. This procedure was developed in response to a complaint by Celstar (the customer). The complaint stated that the wheel crazed at the center of the wheel during use and caused soft spots.