BOMAR® OLIGOMERS

Ash Content Study

bomar-chem.com

BOMAR

Bomar has completed a study that provides ash content data for several Bomar oligomers. Ash content can be determined by thermogravimetric analysis (TGA), a technique used to measure the weight of inorganic substance in an organic material as it is heated or cooled in a controlled environment. This data can provide information about the impurities or organic material leftover in a product after it has been completely burned.

Thermogravimetric Analysis

Thermogravimetric analysis measures the change in weight of a material during heating or cooling. This method can measure the amount and rate of weight change of a material in relation to temperature or time in controlled environments. Specifically, thermogravimetric analysis involves a process called thermal decomposition in which organic material undergoes combustion at high temperatures and is burned off, leaving behind only inorganic species. This remaining product, if any, is known as "ash." Ash content can be studied in various environmental conditions: air, argon, hydrogen, vacuum, as well as a combination of those listed. Determining ash content is important in several applications, including various 3D printing applications.

Ash Content and 3D Printing

In some 3D printing applications, it is important that ash does not remain after being heated at high temperatures. In the manufacturing of 3D printed jewelry, a 3D printed model of a piece of jewelry is built and then a molding material or cement is poured around the 3D printed part to form a mold. This mold will later be filled with metals or other types of jewelry finishes to create the final part. The mold is placed into a furnace to cure the mold and burn off the 3D printed resin. In this step, it is important that no residual printing resin is left in the mold, as it will impact the resolution of fine detail in the jewelry or negatively impact the surface finish of the jewelry.

Ash content data is also relevant to 3D printed ceramic or metal materials that utilize a slurry-based photopolymer resin. In these types of systems, inorganic particles such as metals or ceramics are dispersed in a slurry with a photopolymer resin. The photopolymer is used to form the overall shape of the part as it is selectively cured by UV light to form the base structure of the part. Once the part has been printed via a UV process, the entire part is heated to high temperatures to de-bind and combust the organic materials, leaving only the inorganics. Then the temperature is raised to sinter the inorganics to form a

continuous part. In this application, it is important that the resin is burned off completely with as low of ash content as possible in order to produce high resolution ceramic or metal parts without surface finish errors.

Study Results

During the study, the percentage of ash was recorded at both 500°C and 730°C. The percentage of shrinkage and the temperature at 5% weight loss were also recorded. The data collected shows which materials will perform well in the 3D printing applications discussed.

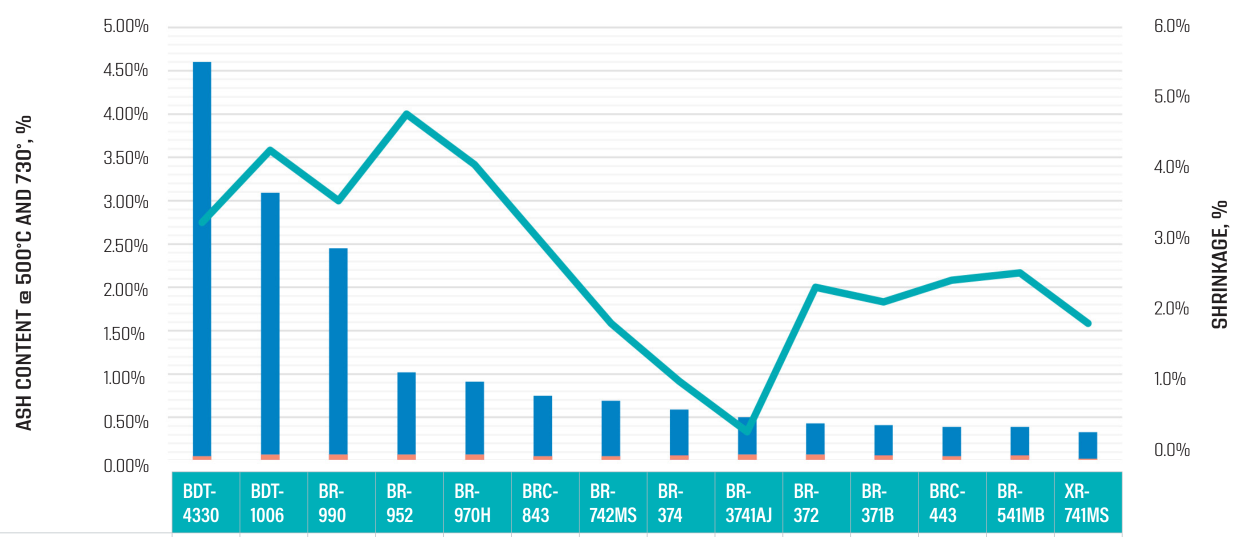
Overall, XR–741MS, BR–742MS, and BRC–443 each have relatively low ash percent at both temperatures, 500°C and 730°C. Materials that had significantly better performance at the high temperature, 730°C, include BDT–4330, BDT–1006, and BR–990. These three materials also exhibit the highest temperatures for 5% weight loss results compared to other products, indicating better stability during the de–binding and sintering stages.

Table 1. Study Results

Product	% Ash @ 500°C	% Ash @ 730°C	Temp. @ 5% wt loss (°C)	Shrinkage*
BDT-4330	4.55	0.05	430	3.3%
BDT-1006	3.02	0.07	408	4.3%
BR-990	2.38	0.07	375	3.6%
BR-970H	0.84	0.07	372	4.1%
BR-742MS	0.64	0.05	372	1.9%
BR-541MB	0.33	0.06	363	2.6%
BR-952	0.95	0.07	359	4.8%
XR-741MS	0.31	0.02	359	1.9%
BR-371B	0.35	0.06	357	2.2%
BR-372	0.36	0.07	353	2.4%
BRC-843	0.70	0.05	350	3.0%
BRC-443	0.34	0.05	344	2.5%
BR-374	0.53	0.06	339	1.1%
BR-3741AJ	0.43	0.07	303	0.4%

* Shrinkage was run on a photo–rheometer and is provided for comparative purposes only.

Figure 1. Ash Content and Shrinkage



	BDT-4330	BDT-1006	BR-990	BR-952	BR-970H	BRC-843	BR-742MS	BR-374	BR-3741AJ	BR-372	BR-371B	BRC-443	BR-541MB	XR-741MS
% Ash @ 500°C	4.55	3.02	2.38	0.95	0.84	0.70	0.64	0.53	0.43	0.36	0.35	0.34	0.33	0.31
% Ash @ 730°C	0.05	0.07	0.07	0.07	0.07	0.05	0.05	0.06	0.07	0.07	0.06	0.05	0.06	0.02
% Shrinkage	3.3	4.3	3.6	4.8	4.1	3.0	1.9	1.1	0.4	2.4	2.2	2.5	2.6	1.9

Global Headquarters: 51 Greenwoods Road | Torrington, CT 06790 | USA | +1 860–626–7006

www.bomar–chem.com