

From Lab to Line: How Mars Mineral Pin Mixers Help Set the Standard for rCB Pellets

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Representative rCB pellets used in laboratory and pilot-scale evaluation of pellet hardness, flowability, and dispersion

From feedstock to pelletizing, better control and standardized testing are unlocking the performance and environmental potential of recovered carbon black.

Two recent open-access studies highlight why high-quality rCB now depends as much on process control and post-processing as it does on the pyrolysis step itself. One of those studies, published in *Polymers* by Norris et al. (2025), used a Mars Mineral Pin Mixer to pelletize rCB before in-rubber testing. The pellets reached a consistent hardness below 80 gram force (gf), demonstrating how reliable agglomeration equipment allows laboratory findings to translate directly into commercial practice.

Why pellet quality matters

Pellet quality has a direct impact on how rCB behaves in production environments, such as rubber manufacturing. Uniform, dense pellets flow cleanly, generate less dust, and disperse predictably during compounding. High-intensity pin mixing, with controlled water addition, creates that repeatability. It builds the structure inside each pellet that gives rCB the strength to handle storage, transport, and mixing without the risk of uncontrolled breakage.

Feedstock consistency and downstream control

Pelletizing cannot fix poor feedstock or uncontrolled pyrolysis conditions, but it plays a crucial role once the chemistry is right. A stable pelletizing process helps preserve the quality achieved upstream. The Mars pin mixer provides the precision needed to maintain pellet strength, shape, and flowability, enabling rCB to perform consistently in downstream operations.

The same relationship between feedstock quality and downstream behavior is reflected in recent studies.

What the research shows about carbonaceous residue and performance

Our experience at Mars Mineral aligns with current research. Most rCB samples we have pelletized over the last several years contained less than about 4% carbonaceous residue and pelletized well using water alone as the binder. When residue levels climbed above 4%, surfactants were often required to wet the powder. That is a practical indicator of surface masking, and it helps producers evaluate their pyrolysis conditions long before full-scale production.



Three steps that separate carbonaceous residue from functional rCB

Across research and practice, three factors consistently determine whether rCB performs like a reinforcing filler or behaves more like inert residue:

- 1. Carbonization control** - Consistent feedstock, stable temperature profiles, and precise residence times help preserve the carbon structure. Without this control, excessive carbonaceous residues and coke may form instead of carbon black.
- 2. Post-treatment and structural recovery** - Removing ash, restoring surface area through post-treatment activation, and refining particle size by milling and pelletizing help restore functional performance.
- 3. Application testing** - The final test is always in rubber performance. Tensile strength, dispersion, dynamic properties, and elongation must match the behavior of virgin N-grade carbon black. This is where pellet consistency becomes essential.

When upstream control is consistent, pelletizing becomes the step that allows rCB to enter the supply chain with confidence.

Standards connect lab to production

As rCB grows into an industrial material, ASTM standards are helping the industry speak a common language. Several methods now play a central role in characterizing rCB quality:

- ASTM D5230-21 for pellet hardness
- ASTM D6556 for surface area
- ASTM D8474-23, a new method specific to rCB, for determining composition and volatile matter
- ASTM D1506-23 for ash content
- ASTM D1618 for toluene discoloration
- ASTM D8474 for bulk composition through thermogravimetric analysis

Using consistent methods helps producers, rubber compounders, and OEMs compare materials and reduce ambiguity in setting specifications.

Life Cycle Assessment connects material quality to environmental impact

As rCB moves toward larger industrial use, environmental performance is becoming as important as technical performance. Bogdahn et al. (2025) in *Advanced Materials & Sustainable Manufacturing* emphasize a consistent characterization of rCB is essential for reliable Life Cycle Assessment (LCA). Their study shows that every step in the rCB pathway influences LCA results. That includes the tire feedstock, the pyrolysis temperature profile, milling and post-treatment steps, and even the pelletizing method.

Once rCB properties are measured using recognized ASTM methods, producers can generate dependable data on energy use, emissions, and product yields. This information creates a clear link between material quality and environmental value, which will become increasingly important as OEMs work toward long-term sustainability goals.

The Mars Mineral Testing Path

Every rCB project at Mars Mineral begins with our Agglomeration Questionnaire to understand the powder characteristics, desired pellet properties, and production goals. From there, pellet development moves through the following steps:

- 1. Pilot testing in the pin mixer** - These runs seek to optimize the process conditions for high first-pass yield of on-spec pellets, provide samples for customer evaluation, and produce up to about 1 ton of pellets for broader testing and performance evaluation.
- 2. Scale-up and production support** - We help match the process to the right equipment, provide budgetary estimates, and assist with commissioning and long-term technical stability.
- 3. Evaluation of the rCB pellets in rubber compounding and testing** - This structured path shortens development time and reduces risk for new rCB producers moving from proof of concept to commercial operation.

Looking ahead

ASTM Committee D36 continues to expand the testing and classification framework for recovered carbon black. As the industry begins to standardize material definitions, producers with strong process control and verifiable data will set the pace. Pelletizing and pellet testing provide the proof points needed to support those claims.

Mars Mineral remains committed to helping rCB producers bridge the gap between laboratory results and full-scale production. By combining process control, the guidance offered by ASTM test methods, and decades of experience in high intensity mixing and agglomeration, we help turn recovered carbon into a consistent, circular material that performs where it counts.



Contact us at info@marsmineral.com or +1 724-538-3000. Or complete our online agglomeration questionnaire to start the conversation.

Further Reading (Open Access)

- *Norris et al. (2025) Polymers – “The Importance of Feedstock and Process Control on the Composition of Recovered Carbon Black”*
- *Bogdahn et al. (2025) Adv. Mat. Sustain. Manuf. – “Production and Characterization of Recovered Carbon Black by Waste Tire Pyrolysis”*