International Journal On Engineering Technology and Sciences – IJETS
ISSN(P): 2349-3968, ISSN (O): 2349-3976
Volume VI, Issue VII, July - 2019

DESIGN AND FABRICATION OF PLASTIC PULVERIZER FOR RECYCLING

NALLAIYA. G
LECTURER /TOOL AND DIE MAKING
MURUGAPPA POLYTECHNIC COLLEGE
CHENNAI 62

ABSTRACT

The plastic pulverizer is a cost-effective and efficient machine that grinds various thermoplastic materials at standard temperatures. It can also be used to recycle production waste in the plastic industry. This machine shreds or crushes materials into smaller pieces by repeatedly hitting them with plates. Pulverizers or grinders are mechanical devices used to grind many different types of equipment. They have numerous uses in various industries. The pulverization machine is used to combine operations, while the pulverizer is used to crush large solid raw materials into smaller sizes. The capper is a machine made up of coarse and fine crushers, wind conveyors, and other components that achieve high-speed impact to crush materials. It uses wind energy to form particles, eliminating the need for traditional netting processes. It is mainly used in mining and construction industries. Agriculture is one of the most important sectors in the Indian economy. To further develop this sector, technology has become a main component. After harvesting crops, farmers typically burn waste materials in the field, creating harmful emissions each year. To make better use of this waste, machines were developed to shred agricultural waste into small pieces, which could then be used for profitable purposes such as power generation and other industries. A design has been developed for a machine that can produce shredded organic waste for farmers without the need for electricity. This machine is more effective and safer than traditional methods that can be harmful to human health, land, and the environment. The machine components include an agitator, hopper, collector tank, bevel gear couplings, pulleys, flat belt drive, and oaring medium.

Keywords: pulverizer; agriculture

1. INTRODUCTION

A Micro Pulverizer is a machine used for grinding and crushing materials into very fine particles. It is a type of pulverizer that is designed to produce a consistent and uniform grind of materials, typically with particle sizes of less than 100 microns. The machine consists of a rotor assembly that is fitted with swinging hammers, and a screen that separates the ground particles from the larger ones. The material to be pulverized is fed into the grinding chamber through a hopper, and as the rotor spins, the swinging hammers impact the material, causing it to break into smaller particles. A hammer mill pulverizer is a type of mill that uses a series of high-speed rotating hammers to reduce the size of solid materials. The hammers are mounted on a central shaft and are free to swing in all directions, striking the material being processed and reducing it to a fine powder or granular form. The material to be pulverized is fed into the mill through a feed chute, and is then struck by the hammers as they rotate at high speeds. The impact of the hammers on the material causes it to break apart into smaller pieces, which are then further ground down by the subsequent impacts. Hammer mill pulverizers are commonly used in the processing of agricultural products, animal feed, and minerals. They are also used in the production of chemicals, pharmaceuticals, and other materials that require fine grinding and particle size reduction. Hammer mills can be used for both dry and wet grinding operations and are available in a variety of sizes and configurations to suit different applications. A plastic pulverizer machine is a type of equipment used to grind plastic materials into fine powder or granules. It is commonly used in the recycling industry to reduce plastic waste and make it easier to transport and process. The machine typically consists of a grinding chamber with a rotating disc or blades that crush and grind the plastic material. The ground material is then collected in a bin or bag for further processing. Plastic pulverizer machines come in different sizes and configurations depending on the specific application and desired output size. Some models may also have additional features such as automatic feeding or cooling systems. A coconut pulverizer is a machine used to grind coconut meat into fine particles. The machine typically consists of a feed hopper, a grinding chamber, a rotor assembly, and a discharge chute. The coconut meat is fed into the hopper and then falls into the grinding chamber where it is pulverized by the rotating blades of the rotor assembly. The pulverized coconut meat is then discharged through the chute. Coconut pulverizers are commonly used in the food industry for the production of coconut flour, which is used as a gluten-free

alternative to wheat flour in baking. They can also be used for the production of coconut milk, which is a common ingredient in many cuisines around the world. The machine can be designed to process different varieties of coconut meat, including fresh or dried coconut meat, as well as desiccated coconut.

A disc pulverizer is a type of grinding machine that uses a rotating disc to pulverize and grind materials. The disc is made of heavy-duty steel or other durable materials and is typically fitted with several removable or replaceable toothed or grooved plates. These plates are designed to pulverize the material as it passes through the machine. The disc pulverizer is commonly used for grinding a variety of materials, including coal, clay, chemicals, minerals, and ores. It can also be used for pulverizing and granulating plastics, rubber, and other materials. The machine works by feeding the material into the top of the pulverizer and allowing it to fall onto the rotating disc. The teeth or grooves on the disc then grind and pulverize the material as it passes over them. A coal pulverizer is a machine used to grind coal into fine particles for combustion in a furnace in power plants. The coal is fed into the pulverizer through a central inlet pipe where it is then crushed between a series of rotating rollers and a stationary grinding ring. The pulverized coal is then collected in a hopper or bin, and it is blown into the furnace through a series of pipes to generate steam to drive turbines and generate electricity. Coal pulverizers are an important component in coal-fired power plants and are designed to achieve high efficiency and low emissions. An AC motor, or an alternating current motor, is a type of electric motor that operates on AC electrical power. AC motors are commonly used in a wide range of applications, including industrial machinery, household appliances, and transportation systems. The basic principle of operation of an AC motor involves the interaction between a magnetic field and a current-carrying conductor. When an alternating current is passed through the stator winding of an AC motor, a rotating magnetic field is created. This rotating magnetic field then interacts with the rotor, which is typically made up of conductive bars or coils, to generate a torque that causes the rotor to turn. AC motors are generally classified into two main types: synchronous and induction motors. Synchronous motors rotate at a fixed speed that is determined by the frequency of the applied voltage, while induction motors operate at a speed that is slightly less than the synchronous speed. Induction motors are the most commonly used type of AC motor due to their simple design, reliability, and cost-effectiveness. A DC motor is a type of electric motor that operates using direct current (DC) electricity. It consists of a stationary part called the stator and a rotating part called the rotor, which is connected to the output shaft. The stator contains electromagnets that create a magnetic field, and the rotor contains a coil of wire that interacts with the magnetic field to produce rotational motion. DC motors are commonly used in a wide range of applications, including in electric vehicles, robotics, industrial machinery, and consumer electronics. They are often preferred over AC motors in applications where precise speed control is required.

Problem statement

The problem statement describes the use of a plastic pulverizer machine as a cost-effective and efficient way of grinding thermoplastic materials at standard temperatures. It also highlights the potential for using this process to recycle production waste in the plastic industry. The statement goes on to explain that a pulverizer is a machine designed to shred or crush material into smaller pieces through repeated blows of plates. These machines have various applications in different industries and are commonly used for grinding various types of equipment. The statement emphasizes that the pulverizer is a versatile machine that can perform multiple operations and is used for combining operations as well. Its primary purpose is to pulverize large-sized solid raw materials into the desired size. Overall, the problem statement highlights the importance and usefulness of plastic pulverizer machines in the plastic industry for cost-effective and efficient grinding and recycling of materials.

Contributions

- Cost-effectiveness: The plastic pulverizer provides a cost-effective solution for grinding plastic materials, as it reduces the need for expensive manual labor and the cost of disposing of production waste.
- Recycling: The pulverizer can be used as a means of recycling production waste in the plastic industry, reducing the environmental impact of plastic waste.
- Efficient grinding: The machine is designed to shred or crush plastic materials into smaller pieces through repeated blows of a number of plates. This ensures efficient and consistent grinding of plastic materials.
- Versatility: The plastic pulverizer has a multitude of uses in various industries, including the plastic industry, chemical industry, and food industry.

Size reduction: The machine is capable of pulverizing large-sized solid raw materials into the required size, making it easier to process and use in various applications.

2. LITERATURE SURVEY

A pulverizer grinder is a machine used for shredding or crushing materials into smaller pieces through the repeated impacts of multiple plates. It is commonly used in various industries for grinding different types of equipment. The purpose of the machine is to reduce large solid raw materials to the desired size. An Impact Pulverizer is a mechanical device used for the grinding of different types of materials. It is also known as an impact grinder or impact pulverizer. This machine operates by using high speed rotating hammers to strike and break the raw material into smaller pieces. The particles are then further reduced in size by striking them against a stationary grinding plate. Impact pulverizers are commonly used in the food, pharmaceutical, chemical, and mineral industries for grinding materials such as spices, grains, herbs, and minerals. They are also used in recycling and waste management to process and reduce the size of various materials for further processing. This book chapter provides an overview of size reduction methods for plastics, including pulverizing. It covers the principles of pulverization, equipment types, and applications [1-2]. This article describes the design and development of a plastic pulverizer machine for recycling plastic waste. It discusses the components, operation, and performance of the machine[3-6]. This study investigates the effects of milling conditions on the properties of polypropylene powder prepared by disc mill pulverization. It discusses the particle size distribution, surface morphology, and thermal properties of the powder. This article describes the development of a disc pulverizer for pulverizing mica waste. It discusses the design, construction, and performance of the pulverizer [7-10]. This study investigates the use of powder rheology for quality control of pulverized thermoplastics. It discusses the effects of pulverization conditions on the flow properties and compressibility of the powder. This article describes the optimization of milling parameters for a plastic pulverizer machine using a genetic algorithm. It discusses the effects of the milling speed, feed rate, and cutter radius on the particle size distribution and energy consumption [11-12]. This study investigates the effect of cooling medium on the particle size distribution of PET powder prepared by high-speed pulverization. It discusses the use of liquid nitrogen as a cooling medium to improve the pulverization efficiency and particle size distribution. This study investigates the effects of operating conditions on the performance of a plastic pulverizer machine. It discusses the effects of the grinding gap, classifier speed, and air flow rate on the particle size distribution and energy consumption. This study investigates the effect of cryogenic grinding on the particle size distribution and rheological properties of polyamide 66 powder. It discusses the use of liquid nitrogen as a cooling medium to improve the pulverization efficiency and particle size distribution [13-15].

Inferences from literature survey

We can infer that plastic pulverization is a widely researched area with a range of applications in recycling and processing of plastic waste. The studies focus on the design, development, and optimization of plastic pulverizer machines, as well as the effects of various operating parameters on the pulverization efficiency, particle size distribution, and quality of the resulting powder. Cryogenic grinding using liquid nitrogen as a cooling medium is also explored in some studies for improved efficiency and particle size distribution. The use of powder rheology for quality control and the development of disc pulverizers for specific materials such as mica waste are also discussed. Overall, the literature suggests that plastic pulverization is a promising technology for plastic waste management and processing.

3. MATERIAL AND METHODS

The process of material selection is crucial in choosing the most suitable materials for industrial and commercial use, as failures due to poor material selection are not uncommon. Various factors such as tensile strength, environmental conditions, and production techniques must be considered before making a final decision. A systematic approach is necessary, starting with defining application requirements and narrowing down choices through elimination. Material property data sheets should not be relied on solely, as actual performance may differ from expected. Material properties such as tensile strength, modulus, flexural strength, impact strength, compressive strength, fatigue endurance, creep, and stress-relaxation must be assessed to ensure design integrity and technical fitness. A good design with proper material selection can better withstand unforeseen loads, chemical damage, and aging. Material engineers must predict working conditions and carefully select appropriate materials accordingly.

Table 1 shows the important components of pulverizers.

Tab 1 important components of pulverizers

Components	Material used	Quantity
Square tube	Mild steel	2 NOS
Hopper	Mild steel	4 NOS
Shaft	Mild steel	2 NOS
Base	Mild steel	4 NOS

Mild steel is a versatile and commonly used type of steel, found in various industries and everyday objects such as kitchen utensils. This article aims to explore the properties of mild steel. As the cheapest form of steel, it accounts for approximately 90% of all steel products in the world. While not readily tempered or hardened, it possesses sufficient strength and is not brittle. Those involved in manufacturing or production should have a good understanding of mild steel's important characteristics, which is especially important for mechanical or metallurgical engineering students. Mild steel is an alloy, created by adding carbon and other elements to iron. These elements are incorporated to achieve specific properties, such as hardness, ductility, and tensile strength. The amount of carbon added affects the properties of the steel. The carbon atoms attach to the small spaces between the iron lattices, making the steel stronger and harder. Mild steel is commonly used as structural steel and in the body and parts of vehicles. It is easy to machine and can have its hardness increased through carbon application.

Mild steel is highly sought after in various industries due to its exceptional properties. Its unmatched weldability and machinability have led to a significant increase in its usage. As the least expensive type of steel, mild steel is widely used in the production of everyday objects such as automobile chassis, motorcycle frames, and cookware. Compared to high-carbon steel, mild steel can be easily welded. The metal's specific properties allow electric currents to pass through it without distorting its composition. This is in contrast to other metals such as stainless steel, which require specialized welding techniques to achieve a professional standard. Using mild steel for fabrication not only saves on man-hours and electrical costs, but also results in a structural finish. **Figure 1** shows the Assembled view of the device (isometric view). **Figure 2** shows the Assembled view of the device (top view).

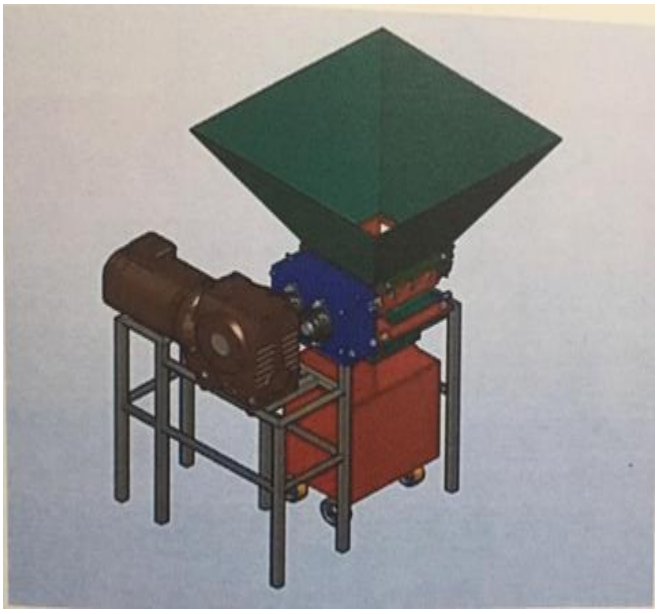

Fig 1 Assembled view of the device (isometric view)

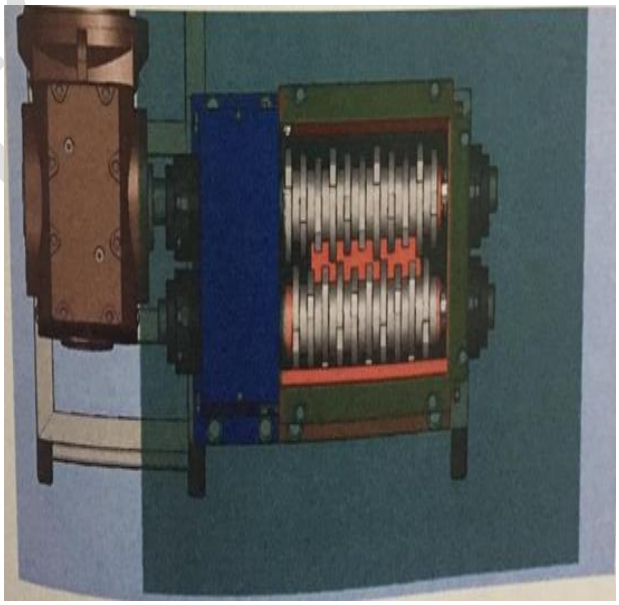

Fig 2 Assembled view of the device (top view)

4. RESULTS AND DISCUSSIONS

The process of using various operations such as welding, drilling, laser cutting, grinding, and turning to create a work is known as fabrication. In this particular paper, a long square mild steel pipe is utilized to create the stand. The pipe is cut to the required dimensions and then welded together to form the stand. Bearings are attached to the stand using bolts and nuts, and holes are drilled into the stand to secure the bolts and nuts. Solid mild steel shafts are used as rollers, with diameters turned on a lathe to fit into the bearings. A circular mild steel plate is welded with a pin and

handle to create the Geneva drive. Another mild steel plate is cut with gas and welded to one side of the shaft, and the grinding machine is used for finishing. Finally, the Geneva drive is assembled with the help of bearings, and all the parts are assembled to create the Geneva operated belt conveyor.

Welding is a fabrication process that involves joining two or more pieces of metal or thermoplastics together by heating the surfaces to their melting point and applying pressure or filler material to create a permanent bond. There are several welding techniques, including MIG, TIG, Stick, and Flux-Cored welding. The selection of the welding technique depends on the material being welded, the thickness of the material, and the desired finish. Welding is widely used in industries such as construction, manufacturing, automotive, and aerospace. It is also used in the creation of artwork, sculptures, and decorative objects.

Drilling is a machining process used to create holes of various sizes and shapes in a workpiece. It involves the use of a drill bit, which is rotated at high speed and pressed against the workpiece. As the drill bit rotates, it cuts through the material, removing chips and creating the hole. Drilling can be performed using a variety of tools, including hand drills, drill presses, and CNC machines. The size and shape of the hole can be controlled by selecting the appropriate drill bit, which come in different sizes and shapes depending on the application. The drilling process can also involve different operations such as countersinking, counterboring, and tapping. Countersinking is used to create a conical depression at the entrance of a hole to accommodate a flathead screw, while counterboring creates a cylindrical recess to accommodate a bolt head. Tapping is used to create threads inside the hole, allowing a screw or bolt to be threaded into the workpiece.

Laser cutting is a technology that uses a high-powered laser beam to cut materials. The laser beam is focused through a lens and directed onto the material, which is typically held on a cutting table. The heat from the laser beam melts or vaporizes the material, creating a cut that is precise and clean. Laser cutting is commonly used in industrial manufacturing to cut a wide variety of materials, including metal, plastic, wood, and fabric. It is also used in the creation of intricate designs and patterns, as the laser beam can be programmed to follow specific paths and cut shapes with high accuracy. Some of the advantages of laser cutting include its ability to cut through a wide range of materials, its precision and accuracy, and its ability to produce clean cuts without requiring additional finishing processes. However, laser cutting can also be expensive and may not be suitable for all types of materials or cutting applications. Grinding is a machining process that uses a rotating abrasive wheel or tool to remove material from a workpiece. The abrasive grains on the wheel or tool cut into the material, creating a flat or contoured surface. Grinding is typically used for finishing operations, such as smoothing rough edges or removing excess material from a part. There are several types of grinding processes, including surface grinding, cylindrical grinding, centerless grinding, and internal grinding. Surface grinding is used to create a smooth finish on flat surfaces, while cylindrical grinding is used to create a round shape on the outside of a workpiece. Centerless grinding is used to create precise cylindrical shapes, and internal grinding is used to create precise holes or bores in a workpiece.

Grinding can be performed on a variety of materials, including metal, plastic, and ceramics. The abrasive material used for grinding varies depending on the application and can include aluminium oxide, silicon carbide, diamond, and cubic boron nitride. Grinding is a precise and efficient method of removing material from a workpiece, but it can generate a significant amount of heat, which can cause the workpiece to warp or distort. To prevent this, coolants are often used during the grinding process to help dissipate heat and keep the workpiece cool. Turning is a machining process that involves rotating a workpiece on a spindle while cutting it with a cutting tool. The cutting tool is held in a tool holder that moves along multiple axes to create the desired shape or surface finish. Turning is commonly used to create cylindrical parts, such as shafts, bolts, and bushings. There are several types of turning processes, including external turning, internal turning, and facing. External turning is used to create cylindrical parts on the outside surface of a workpiece, while internal turning is used to create cylindrical parts on the inside surface of a workpiece. Facing is used to create a flat surface at the end of a workpiece. Turning can be performed on a variety of materials, including metal, plastic, and wood. The cutting tool used for turning can also vary depending on the material being machined and the desired finish. Carbide inserts are commonly used for metal turning, while high-speed steel or diamond tools are used for other materials. Turning is a precise and efficient method of creating cylindrical parts with a variety of shapes and sizes. It can be performed on both manual and CNC (computer numerical control) machines and can produce parts

with high accuracy and surface finish. **Figure 3** shows the final stage of the device.

Fig 3 final stage of the device

Pulverizer grinders, also known as pulverizers or jet mills, are machines used for grinding solid materials into fine powders. They are commonly used in the pharmaceutical, food, chemical, and mineral industries for size reduction and particle classification. Here are some of the applications and advantages of pulverizer grinders: Pulverizer grinders are used for grinding active pharmaceutical ingredients (APIs) and other materials into fine powders for tablet pressing and other drug delivery forms. Pulverizer grinders are used for grinding spices, sugar, grains, and other food materials into powders for seasoning, baking, and other food processing applications. Pulverizer grinders are used for grinding various chemical compounds into fine powders for use in chemical reactions, catalysts, and other applications. Pulverizer grinders are used for grinding various minerals into powders for use in ceramics, glass, and other industries. Pulverizer grinders are highly efficient in reducing the size of solid materials, producing fine powders with a narrow particle size distribution. Pulverizer grinders can be used for grinding a wide range of materials, including hard and brittle materials, fibrous materials, and heat-sensitive materials. Pulverizer grinders can be designed with dust collection systems, which allow for a dust-free operation, minimizing the risk of contamination and promoting a safe working environment. Pulverizer grinders can be designed to handle different batch sizes, making them suitable for both laboratory and industrial-scale applications. Pulverizer grinders are relatively low-cost machines and require minimal maintenance, making them an economical choice for size reduction and particle classification applications.

5. CONCLUSION

The plastic crusher is an important addition to industries involved in plastic waste management, as it significantly reduces the overall cost of recycling and minimizes the amount of labor required. Our plastic pulverizer grinder system is highly efficient, producing high-quality granules with a narrow particle size distribution. However, we believe that the efficiency of the system can be further improved by increasing the size and power of the AC motor, which would allow for faster and more effective grinding of plastic waste. This would make the developed plastic pulverizer grinder suitable for use in safe manufacturing environments in various industries. The plastic pulverizer grinder system will be a valuable addition to industries involved in plastic waste management and will help to promote sustainable practices in the manufacturing sector.

REFERENCES

1. "Plastic Pulverizer Market - Global Industry Analysis, Size, Share, Growth, Trends, and Forecast 2019 - 2027" by Transparency Market Research.

2. "Design and Fabrication of a Plastic Pulverizer Machine" by Olukunle O. Oyedepo, Ayodeji A. Ogunyemi, and Isaac I. Adetunde.

3. "Optimization of Operating Parameters of a Plastic Pulverizer" by Wutthipong Pongtanalert, Somchai Wongwises, and Perapong Tekasakul.

4. "Development of a Plastic Pulverizer for High-speed Powder Coatings" by Mingqiang Liu, Yongtai Zhang, and Xiaoguang Yu.

5. "Thermomechanical and Structural Properties of Polypropylene-Based Wood-Plastic Composites: Effects of Triethylene Glycol Dimethacrylate and Pulverization with Disc Mill Pulverizer" by Kohei Shoji, Takayuki Yamamoto, Yuto Mizutani, and Takashi Endo.

6. "Production of Micronized Polyethylene Powder Using Rotary Disc Atomizer and Pulverizer" by Hyun Suk Shin, Seok Yun Lee, and Sang-Woo Kim.

7. "Study on Size Reduction of Vulcanized Rubber Waste Using Disc Pulverizer" by Muhammad Fattah Faisal, Muhammad Rusydi Ramli, and Shahreen Kasim.

8. "Effect of Operating Conditions and Blade Profile on the Grinding of Waste Polyethylene Terephthalate Bottles Using

a Rotary Knife Pulverizer" by Sheng-Yang Wang, Yi-Hsuan Lin, and Ching-Hua Huang.

9. "Size Reduction of Low-Density Polyethylene by a Cryogenic Liquid Nitrogen Pulverizer" by Noppadol Phakdee, Jirasak Tharajak, and Chiraphon Chiarakorn.

10. "Comparison of Dry and Wet Grinding of Coals in a Ball Mill and in a Ceramic Pulverizer" by Jihong Huang, Jingru Chen, and Zhenfu Luo.

11. "Simulation and Experiment Study on the Particle Size Distribution of Powder Coatings Produced by Grinding with a High-Speed Pulverizer" by Jianjun Chen, Chenyang Zhao, and Shouxiang Wang.

12. "Preparation and Characterization of Polypropylene/Recycled Polyethylene Terephthalate Composites by Ball Mill Pulverization" by Na Yu, Wei Song, and Zhongxin Zhou.

13. "Characterization of Particle Size Distribution of Pulverized Waste Polyurethane Foam by Laser Diffraction" by Jong-Oh Kim and Joo-Ho Kim.

14. "Effect of Different Pulverization Methods on the Physical and Mechanical Properties of High-Density Polyethylene/Polypropylene Blends" by Xiangpeng Gao, Xuefeng Zhou, and Wei Zhang.

15. "Particle Size Reduction of Pigments Using a Small Media Mill and a High-Speed Disperser" by Robert Ian Murray, Michael Breuer, and Mike Chapman.