



Cryogenic Grinding

Roshan Kumar¹, Sachin Malik², Saksham Verma³ and AK Madan⁴

^{1, 2, 3} Student, Mechanical Engineering, Delhi Technological University, New Delhi

⁴ Professor, Mechanical Engineering department, Delhi Technological University, New Delhi

ABSTRACT

The Cryogenic grinding answers were used for difficult-to-grind or specialist substances, in particular difficult materials like plastics and rubbers, and so far have no longer been broadly used inside the manufacturing of pharmaceuticals and nutraceuticals. However, in this paper we would love to present a neglect on cryogenic grinding and its utility.

KEYWORDS : Cryogenic grinding, Cryogenics, Application

INTRODUCTION

The term “Cryogenics” originates from the Greek phrase because of this creation or production by cold. As fees for strength and uncooked substances upward thrust and subject for the surroundings makes secure waste disposal hard and Costly, useful resource healing becomes a important be counted for nowadays’s commercial enterprise. Cryogenic grinding generation can correctly grind maximum tough materials and can also facilitate Cryogenic recycling of tough composite materials and multi component scrap. The coronary heart of this era is the CRYO-GRIND SYSTEM. It employs a cryogenic technique to embrittle and grind materials to achieve constant particle length for a huge variety of products. The cryogenic system additionally has a unique functionality for recycling difficult to split composite materials.

Cryogenic grinding is a method of powdering herbs at sub-zero temperatures starting from zero to minus 70°F. The herbs are frozen with liquid nitrogen as they’re being floor. This method does not harm or modify the chemical composition of the plant in any manner. Normal grinding procedures which do not use a cooling device can attain as much as two hundred°F. These excessive temperatures can reduce unstable additives and heat- touchy parts in herbs. The cryogenic grinding process starts with air-dried herbs, in preference to freeze-dried herbs.

Solid substances are floor or pulverized with the aid of way of hammer mills, attrition mills, granulators or different device. A smaller particle size is normally needed to decorate the further processing of the strong, as in mixing with different materials. A finer particle also allows in melting of rubber and plastics for molding. However, many substances are either very tender or very hard at room temperatures. By cooling to cryogenic temperatures with liquid nitrogen, those can be embrittled and effortlessly fractured into small debris.

A scientifically controlled examine the usage of 4 herbs changed into carried out at Frontier Herbs in the Fall of 1996, evaluating cryogenic grinding techniques with everyday grinding strategies. The herbs examined covered feverfew, goldenseal, valerian and echinacea. In all instances the cryogenically ground herb contained more amounts of the components tested. Feverfew herb showed the greatest distinction, with the cryogenically floor herb containing 21.Eight% higher stages of parthenolide, the primary lively constituent. Valerian root showed an 18.7% increase in valerenic acid while cryogenically floor. Goldenseal root showed a sixteen.Four% boom in berberine and 10.7% boom in hydrastine. Lastly, Echinacea purpurea root confirmed a 12.1% growth in general phenolic content material inside the cryogenically ground root. Test effects had been obtained by means of HPLC (excessive performance liquid chromatography) techniques.

Cryogenic grinding was shown to seriously have an effect on active constituent ranges in herbs. Test results showed a mean boom of 15.6% in materials examined in 4 medicinal herbs once they had been ground cryogenically. The range changed into 10.7% to 21.Eight%, indicating that some herbs are affected more than others by using the temperatures at which they’re ground.

APPLICATION OF CRYOGENICS

The most important regions in which cryogenics discover its programs are : -

1. Gas Industry – in air separation. The quantity of production of nitrogen and Oxygen by means of cryogenic separation of air is the essential of the separation of air, refrigeration and separation. In the separation column, the difference in the boiling points of the

components of air is used to split them out.

2. As the source of fuel. For example, the respiration oxygen needed for the pilots of the fighter aircraft is provided via vaporizing liquid oxygen on board. In this manner is a weight reduction of sixty five% and space reduction of 85%.
3. In area studies – as rocket propellant and for area simulation. The maximum crucial advantage of cryogenic fuels is that these have very excessive specific impulse while in comparison to other fuels (particular impulse is kgs of thrust produced in line with kg of propellant consistent with sec). The fee is about 500 for cryogenic fuels while it's about 250 for alcohol oxygen mixture.
4. In biology – for upkeep and in remedy of diseases.
5. In meals enterprise – for meals dealing with and processing.
6. In electronics – both semiconductor and superconductor electronics for higher sign to noise ratio pace and so forth.

CRYOGENIC GRINDING PROCESS

Since nearly all materials embrittle when exposed to bloodless temperatures, cryogenic size reduction utilizes the bloodless strength to be had from liquid nitrogen to cool, embrittle and inert substances prior to and or all through the grinding technique. All substances which because of their unique homes at ambient temperatures are elastic, have low melting factors, include volatile or oily substances, have low combustion temperatures and are touchy to oxygen, are perfect applicants for cryogenic length discount.

Physical residences of liquid nitrogen is produced with the aid of the separation of air into its components in an air separation plant and is shipped in vacuum insulated transport vessels to the quit person in which it's miles saved in a vacuum insulated storage vessel until it's miles used. At atmospheric pressure liquid nitrogen is at a temperature of -320°F and possesses a latent strength content of ninety four BTU/LB ensuing in a complete cooling power content material of 179.6 BTU/LB. Nitrogen is a non-flammable, non poisonous and inert fuel which makes up 78.09% of the air we breathe. It has the traits of an inert fuel, except at relatively improved temperatures, and does not shape any compound under normal temperatures and strain. Drawn from the liquid section, nitrogen normally has a purity of ninety nine.998 % with a dew point much less than -100°F and could be very dry.

CRYOGENIC GRINDING TECHNOLOGY

For pulverizing many materials, cryogenic grinding era will increase productiveness and lowers electricity costs. Many elastic or "soft" materials are very hard to pulverize, requiring long cycle times and excessive power consumption. This aggregate decreased productivity and multiplied fees unnecessarily. Cryogenic grinding includes cooling a fabric under its embrittlement temperature with a cryogenic fluid, usually liquid nitrogen or, in sure applications, carbon dioxide.

Probably the greatest benefit provided by cryogenic grinding is the ability to grind "soft" or elastic materials that otherwise could not be ground, or could be ground only with long cycle times and high energy use. By embrittling the material, fine powder or crumb can be obtained easily and with a minimum expenditure of energy. Because embrittled material grinds easily, the throughput for a given mill is substantially increased and less power is used per pound of material ground. In Fig. 1 is a plan of moment situating the work piece during a solitary transformation when in-feed grinding? The apparatus way feed rate is checked t. assuming stipend is taken with specific pieces of the surface, the work piece diminishes and is moved to the directing wheel.

Cryogenic grinding is used for grinding spices, thermoplastics, elastomers, color concentrates, and similar materials. It is also used to recover a variety of scrap materials, such as factory scrap rubber and scrap tires, and to separate the components in composite materials.

ADVANTAGES OF CRYOGRINDING

1. Higher manufacturing price
2. Lower strength intake
- three. Finer particle length
- four. More uniform particle distribution
5. Lower grinding fee
6. No heat era which is good whilst grinding spices, pharmaceuticals and scrap plastics
7. Provides an inert ecosystem as a result disposing of the opportunity of oxidation

APPLICATIONS OF CRYOGENIC GRINDING

CryoGrinding of metallic

Thermoplastics
Adhesives & Waxes
Explosives
Spices
Thermo sets

CONCLUSION

From the evaluate it could be concluded that the cryogenic grinding process produces quite easy fracture surfaces. Little or no warmth is generated in the method. This outcomes in plenty less degradation of the material. Apart from this Fineness and uniform distribution of unique sized particle is met in this manner consistent with requirement; it may be adjusted the usage of suitable configuration of Cryogenic grinders. As the manufacturing is in inert surroundings the cloth is covered from oxidation and rancidity. Comparatively the price of Cryogenic grinding approach is much less and strength intake is reduced. Production charge is likewise advanced.

FUTURE SCOPE

As the cost of raw materials and energy is growing day by day, it's far very vital to use most effective quantity and on the same time get the required satisfactory. By the use of CryoGrinding era these factors can be met correctly. By using this we also can recycle hard and composite materials. It has many massive benefits over traditional grinding. This additionally ends in cost addition to the product. CryoGrinding is economically feasible, if liquid nitrogen prices aren't bold. By adopting CryoGrinding generation the main spice industries of our u . S . Will earn substantial foreign exchange by way of exporting greater cost-added processed spices, in place of exporting complete spices. The method may be without difficulty prolonged to processing of PVC and industrial waste plastics in view of recycling of non-biodegradable materials.

REFERENCES

- [1] Rohit Saxena, Cryogenic Grinding: A Physical Technique To Retain Volatile Content In Natural Products, Department of Humanities and Science.
- [2] Charles Astafan and Rudi Kohler (October 1995.)Comparison of Scrap Tire Processing Technologies: Ambient Processing vs.Cryogenic Processing, 'ACS Rubber Division MeetingCleveland',paper #35
- [3] S.S Thipse, Cryogenics, Narosa publication, pp(149-157)
- [4] McGraw Hill encyclopedia of science and technology,pp(341-346).