Applied Minerals, Inc.
Form 10-K
March 14, 2014

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, DC 20549

FORM 10-K

x ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(D) OF THE SECURITIES EXCHANGE ACT OF 1934

For the year ended December 31, 2013

Commission file number: 000-31380

APPLIED MINERALS, INC.
(Exact name of registrant as specified in its charter)

Delaware	82-0096527
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)

110 Greene Street – Suite 1101, New York, NY	10012
(Address of principal executive offices)	(Zip Code)

(800) 356-6463
Issuer's telephone number, including area code

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act.
YES o NO x

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act:
YES o NO x

Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days.
YES x NO o

Indicate by check mark whether the registrant submitted electronically and posted on its corporate website, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files).
YES x NO o

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulations S-K is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.
o

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, or a smaller reporting company. See the definitions of “large accelerated filer,” “accelerated filer” and “smaller-reporting company” in Rule 12b-2 of the Exchange Act.

Large Accelerated Filer o Accelerated Filer x Non-accelerated Filer o Smaller Reporting Company o

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). YES o NO x

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant on June 30, 2013, based on the last sales price on the OTC Bulletin Board on that date, was approximately $70,815,535.

As of March 10, 2014, there were 94,710,197 common shares outstanding.

APPLIED MINERALS, INC.
YEAR 2013 ANNUAL REPORT ON FORM 10-K
TABLE OF CONTENTS

Table of Contents

NOTE REGARDING FORWARD LOOKING STATEMENTS

This Annual Report on Form 10-K contains "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. These forward-looking statements are based on our current expectations, assumptions, estimates and projections about our business and our industry. Words such as "believe," "anticipate," "expect," "intend," "plan," "will," "may," and other similar expressions identify forward-looking statements. In addition, any statements that refer to expectations, projections or other characterizations of future events or circumstances are forward-looking statements. These forward-looking statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those reflected in the forward-looking statements. Factors that might cause such a difference include, but are not limited to, those discussed in the section of this Annual Report entitled “1A. RISK FACTORS.”

Given these risks and uncertainties, readers are cautioned not to place undue reliance on our forward-looking statements. Projections and other forward-looking statements included in this report have been prepared based on assumptions, which we believe to be reasonable, but not in accordance with United States generally accepted accounting principles (“GAAP”) or any guidelines of the Securities and Exchange Commission (“SEC”). Actual results may vary, perhaps materially. You are strongly cautioned not to place undue reliance on such projections and other forward-looking statements. All subsequent written and oral forward-looking statements attributable to Applied Minerals, Inc. or to persons acting on our behalf are expressly qualified in their entirety by these cautionary statements. Except as required by federal securities laws, we disclaim any intention or obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise.

PART I

Item 1. Business

OVERVIEW

Applied Minerals, Inc. (the “Company” or “we” or “us”) is focused primarily on (i) the development and marketing of our halloysite clay-based Dragonite™ line of products for use to improve the performance of end-products in application markets such as flame retardant additives for plastics, nucleation, thermosets and adhesives, reinforcement, molecular sieves and catalysts, ceramics, binders, cosmetics, controlled release carriers and environmental remediation and (ii) the development and marketing of our Amiron™ line of iron oxide products for pigmentary and technical applications.

The Company owns the Dragon Mine, which has significant deposits of high quality halloysite clay and iron oxide. The 267-acre property is located in southwestern Utah and its resource was mined for halloysite on a large-scale, commercial basis between 1949 and 1976 to be used as a petroleum cracking catalyst. The mine was idle until 2001 when the Company leased it to develop its halloysite resource for advanced, high-value applications. We purchased 100% of the property in 2005.

Halloysite is an aluminosilicate clay that possesses a tubular morphology with a hollow lumen (pore). Traditionally, halloysite has been used to manufacture porcelain, bone china and catalysts used in the petroleum cracking process. A significant amount of academic research has been performed on the commercial uses of halloysite clay beyond porcelain products and ceramic catalysts. This research has identified a wide array of application areas in which the unique morphology of halloysite can be utilized to either enhance the performance of existing applications or create new high performance ones. Since 2009, management has been primarily focused on developing halloysite-based products for advanced applications, such as, but not limited to, additives for polymer composites. The clays used in these advanced applications sell for significantly higher than those of the more traditional applications. Nanoclays have been used as additives to develop high performance plastic composites that cannot be developed using traditional fillers. Nanoclays, such as treated montmorillonite, sell for up to $5,000 per ton due, in large part, to the cost associated with exfoliating the clay so it may be properly dispersed within a polymer matrix. Halloysite has been shown to be as effective a polymer additive as nanoclay without requiring a costly exfoliation to disperse it within a polymer matrix. The Company has and continues to utilize a number of PhD-level consultants to research and develop the use of halloysite in advanced applications.

In addition to the development of its halloysite resource, management has also developed a line of iron oxide-based products for the pigmentary and technical markets. The Dragon Mine's 3.3 million tons of natural iron oxide mineralized material are comprised primarily of goethite and hematite. Initially, the resource was considered to be utilizable as only an input to the steel-manufacturing process but, upon additional analysis, the iron resource was found to be an advanced iron oxide due to its high Fe_2O_3 content, exceptional chemical purity, fine grains and good dispersability good tinting strength and color saturation, low color variation and a low content of heavy metals. Advanced iron oxides have commercial uses in a number of higher value applications such as the aforementioned pigmentary and technical markets. The Company's Amiron product line includes semi-transparent and FDA-compliant pigments for the construction, concrete, paints and coatings, and plastics and rubber industries. Amiron Technical Oxides, due to their particularly high surface area of 25 m^2/g – 125 m^2/g and reactivity, can be used as the media for the removal of toxins from waste and drinking water and as a catalyst for desulfurization. The Company has made its first sale of Amiron to a customer for use as a pigment.

The Company has carried out an extensive drilling program to characterize the mineralized material at the Dragon Mine. The Company has also recently commissioned a 45,000 tpa mineral processing plant at its Dragon Mine property. This facility utilizes Hosokawa-Alpine technology that (i) enhances the Company's ability to control the processing of its mineral resource for qualities such as particle size, moisture and purity and (ii) apply a range of surface treatments to its processed minerals.

Applied Minerals is a publicly traded company incorporated in the state of Delaware. The common stock trades on the OTCQB under the symbol AMNL.

RECENT BUSINESS DEVELOPMENTS

- During the fourth quarter of 2013 and the first quarter of 2014, the Company appointed three new Board members: Mario Concha, former president of the Chemical Division of Georgia Pacific, Inc.; Robert Betz, formerly of Cognis Corp., the North American division of Cognis GmbH, a $4 billion worldwide supplier of specialty chemicals and nutritional ingredients, and Henkel AG & Company; and Ali Zamani, a former Principal at SLZ Capital Management, a New York-based asset management firm, and former senior investment professional at Goldman Sachs Investment Partners and Goldman Sachs Principal Strategies. Evan Stone resigned as a director on December 31, 2013; Mr. Stone, an attorney, resigned because he joined a new law firm as of January 1, 2014 and it is the policy of the new firm that its lawyers may not serve as directors of public companies. Mr. Stone had no disagreements with the Company or the Board of Directors. The foregoing changes expanded the Board to six directors and the number of independent directors to four.

- In December 2013, the Company launched its Amiron line of iron oxide products focused particularly on the pigmentary and technical markets.

- In December 2013, the Company entered into a distribution agreement with Mitsui Plastics, Inc. to market, sell, and distribute its Dragonite halloysite clay and Amiron iron oxide outside of North America.

- The Company announced that it entered into an agreement with OPF Enterprises, LLC ("OPF"), a leading ceramic consulting firm that focuses on ceramic materials and process development, to introduce Dragonite and Amiron to certain ceramic and iron oxide application markets for which it has particular expertise and customer relationships.

Table of Contents

- In October 2013, the Company issued an updated JORC - compliant report regarding the mineralization at the Dragon Mine property with respect to its clay and iron oxide resources.

- In August 2013, the Company announced that it successfully raised $10,500,000 of financing through the private placement of 10% Mandatorily Convertible PIK Notes due 2023 ("Notes"). The Notes have a strike price of $1.40 per share and convert into 7,500,000 shares of the common stock of Applied Minerals, Inc. The purchasers of the Notes included one current shareholder and two new investors of the Company.

- In June 2013, the Company sold its first 10 tons of iron oxide to a leading specialty chemicals company for use in the absorption and catalyst market.

- In April 2013, the Company announced the signing of an agreement with Sigma-Aldrich Corporation (NASDAQ: SIAL), a leading Life Science and High Technology company, to market and distribute Dragonite to researchers worldwide through the Aldrich Materials Science initiative.

- During the second and third quarters of 2013, the Company made some key personnel changes, including the appointment of an individual from a leading global specialty chemicals company to lead its Iron Oxide Business Unit and the hiring of a new Chief Technology Officer.

- In January 2013, the Company sold, in a privately negotiated transaction, 3,756,757 shares of its common stock at $1.48 per share for gross proceeds of $5,560,000. No broker was used and no commission was paid as part of this transaction.

DRAGON MINE

The Dragon Mine is located in the Tintic Mining District approximately 10 miles south of Eureka, Utah and approximately 75 miles southwest of Salt Lake City, Utah. The Dragon Mine property covers approximately 267 acres with a large mining permit from the state of Utah allowing for the extraction of minerals throughout the property. The mine can be operated year-round.

Mineralization Material and Reserves

The Company does not have mineral “reserves,” as that term is defined in the Securities and Exchange Commission’s Industry Guide 7. The Company has declared measured and indicated “resources” under the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the “JORC Code”). Among the differences between Industry Guide 7 and the JORC Code are (i) Industry Guide 7 requires additional steps, such as a mine plan and (ii) tonnages reported under Industry Guide 7 are net of mining losses and processing while tonnages under the JORC Code are reported in situ (in the ground) without allowances for mining losses and processing. For SEC reporting purposes, the Company may report tonnage and grade of mineralized material in situ. Unless and until the Company establishes reserves under Industry Guide 7, it will be classified for SEC reporting purposes as an “exploration” stage company and is not eligible to be classified as a “development” or “production” stage company.

The Company’s exploration activities to date at the Dragon Mine have been divided into three separate geographical areas. Note that the information about tonnages and grade are estimates determined in accordance with the procedures set forth under “Procedures Used to Develop the Tonnage and Grade Results.” Currently, the three geological areas of the Dragon Mine are:

Dragon Pit

The Dragon Pit area covers 4.95 acres and is mined underground. There are three separate types of mineralized material in the Dragon Pit area. The first type is comprised of clay with a relatively high concentration (~ 94%) of halloysite. The Dragon Pit contains 625,650 tons of this type of mineralized material.

The second grade found in the Dragon Pit is comprised of a mix of kaolinite, illite-smectite, and halloysite clays. Clays constitute approximately 73.4% of this mineralization of which halloysite constitutes approximately 42.6%, kaolinite constitutes 19.2% and illite-smectite constitutes 11.6%. The Dragon Pit contains 565,575 tons of this type of mineralized material.

The third type of mineralized material found in the Dragon Pit is comprised of iron-bearing materials. This mineralization contains goethite (an iron hydroxide) and hematite (an iron oxide). We will refer to both minerals as "iron oxide." The mineralization is approximately 94% iron oxide on a mineralogical basis, of which goethite accounts for 69.7% and hematite 24.3%. There exist separate areas of goethite and hematite but the majority of the iron-bearing mineralization in the Dragon Pit exists as a goethite-hematite mix. The Dragon Pit contains 2,631,825 tons of this iron-bearing mineralization.

Western Area

The Western area covers 6.33 acres and is mined underground. There are two different types of mineralization in the Western Area.

One type of mineralization in the Western Area is comprised primarily of a mix of kaolinite, illite-smectite, and halloysite clays. The clay content of this mineralization is approximately 71.4%, of which kaolinite constitutes 47.2%, illite-smectite constitutes 17.5% and halloysite constitutes 6.7%. The Western Area contains 862,903 tons of this type of mineralization.

Table of Contents

The other type of mineralization is iron-bearing. The Western Area contains goethite and hematite. The mineralization is approximately 96% iron oxide on a mineralogical basis, of which hematite accounts for 75.9% and goethite 20.1%. There exist separate areas of goethite and hematite but the majority of the iron-bearing mineralization in the Western Area exists as a goethite-hematite mix. The Western Area contains 670,450 tons of this iron-bearing mineralization.

Surface Piles

There are five surface piles that were created during the mining of halloysite clay by Filtrol between 1949 and 1976. Filtol mined the Dragon Mine's halloysite resource for use as a petroleum cracking catalyst. Any clay that contained more than a minimal amount (~ 2%) of iron oxide was not usable for petroleum cracking and was discarded into one of five surface piles. We view the Surface Piles as a possible source of revenue.

The following sets forth information about the mineralized material by surface pile:

		Average Clay Content (%)			
Surface Pile	Clay (tons)	Halloysite	Kaolinite	Illite-Smectite	Total
1	154,500	41.8	25.8	9.4	77.0
2	127,100	19.0	33.6	27.8	80.4
3	298,900	9.4	30.7	24.9	65.4
4	33,280	13.2	31.7	31.7	76.7
5	144,100	13.5	13.5	31.8	81.8

Procedures Used to Develop the Tonnage and Grade Results

The following describes sample collection, sample preparation, and the analytical procedures used to develop analytical results set forth above for the Dragon Pit, the Western Area, and the Surface Piles.

Surface surveying positioning of holes was carried out using sub-centimetre Trimble GPS Receivers (base station and Rover) with accuracy within 5mm. Underground surveying utilized a Topcon GTS3 Total Station which measures angle to one second and measures distances to parts per million. A DSI (Deviation Survey Instrument) SRG (Surface Recording Gyro) was utilized to measure deviation of the hole. A Brunton compass is used to determine a reference line. Readings are taken every 50' during the survey and a final reference reading is used to calculate the hole's overall drift. When run correctly the instrument is accurate to within 1 foot per 1000' of depth.

Core drilling was carried out and for all boreholes the driller placed the core into a box, which was carefully labeled with borehole number, depth reached and any voids noted. A LCF (Lithology Control File) was established for each area and w included all rock types identified. The borehole number, coordinates, elevation, inclination, azimuth and depths drilled were entered into a log showing the LCF.

The following analyses were carried out by Macaulay Scientific Consulting Ltd, Analytical Laboratory Services on the clay extracted from the drill holes: Moisture Content; XRD identification; XRPD quantitative analysis; _XRPD Formamide test; SEM imaging; FTIR analysis; BET Surface Area / Porosity; Qualitative EDS; XRF; ICP—MS for trace elements; MINOLTA – Color and brightness measurements. For analysis of the iron oxide, XRD, ICP-MS, BET Surface Area, Color and Brightness measurements were carried out by James Hutton Institute. ALS Minerals Laboratory in Reno, Nevada carried out analytical procedures ME-XRF21u, Iron oxide by XRF Fusion – normalized (XRF Instrument), OA-CRAE05x, LOIS for XRF (WST-SEQ) AND Au-ICP21, Au 30g FA ICP-AES Finish (ICP-AES Instrument)

Logging was carried out in line with the Lithology Control File. All of the data was then entered into a spreadsheet to show Borehole Number, coordinates, elevation and individual test results for each of the increments sampled and tested.

The Company utilized the PC/Core software package to convert raw borehole data and assumptions by the Company into a mathematical model using block model interpolation. The program provides for the production of "Quality Array Reports," each of which shows the correlation between one variable and all of the other variables in the model.

Deep Drilling for Other Minerals

During the first quarter of 2013, as part of the Company's drill program carried out to explore for halloysite and iron oxide in the Dragon Pit area of the property, the Company drilled a hole in the Dragon Pit area. To explore the possibility of a copper porphyry, it continued to drill further, to 3,218 feet. In the 2,056.5 – 2,166.0 ft. levels, there was sulphide mineralization showing a silver and tellurium signature. The results of the drilling by themselves do not indicate a commercial deposit. Whether there is any commercial deposit, however, cannot be determined from one drill hole and would have to be proven by further drilling and would have to take into account the costs of mining at that depth.

Description of Minerals at the Dragon Mine

Clays

Kaolinite and halloysite are clays and members of the kaolin group of clays. Both are aluminosilicate clays. Kaolinite and halloysite are essentially chemically identical, but have different morphologies (shapes). Kaolinite typically appears in plates or sheets. Halloysite, in contrast, typically appears in the shape of hollow tubes. On average, the halloysite tubes have a length in the range of 0.5 - 3.0 microns, an exterior diameter in the range of 50 - 70 nanometers and an internal diameter (lumen) in the range of 15 - 30 nanometers. Formation of halloysite occurs when kaolinite sheets roll into tubes due to the strain caused by a lattice mismatch between the adjacent silicon dioxide and aluminum oxide layers.

Table of Contents

Kaolinite is one of the world’s most common minerals. U.S. production in 2011 was 5.5 million tons.

Halloysite is by comparison is a rare mineral, with worldwide production of less than about 30,000 tons. The only other large commercial-sized halloysite mine is owned by Imerys and is located in New Zealand. There are relatively pure halloysite deposits in the China, but those deposits require hand-picking and have very limited production.

Illite refers to a group of clays that includes hydrous micas, phengite, brammalite, celadonite, and glauconite. Illite clays are common and large amounts are produced each year.

Smectite refers to a group of clays that includes montmorillonite, bentonite, nontronite, hectorite, saponite and sauconite. Smectite clays are common clay and large amounts are produced each year.

Iron Oxide

Hematite is the mineral form of iron oxide exists in a range of colors, including black to steel or silver-gray, brown to reddish brown, or red.

Geothite is an iron hydroxide oxide mineral exists in a range of colors, including yellowish to reddish to dark brown. If goethite is sufficiently heated to eliminate the water, it is transformed into hematite.

Mixtures of goethite and hematite are color brown.

Processing Facilities

All of the mineralization extracted from the Dragon Pit, Western Area and surface piles requires processing before it can be commercially sold. The Company recently commissioned a 45,000 tpa Hosokawa Alpine mineral processing facility. This mill enables the Company to (i) control the processing of its mineral resource for qualities such as particle size, moisture and purity and (ii) apply a range of surface treatments to processed minerals. These enhanced capabilities are necessary to produce material that meets the performance criteria required by the advanced application markets to which we are marketing our products. Prior to the commissioning of the 45,000 tpa facility, the Company utilized a smaller mill to process its minerals. The Company plans to utilize both facilities to process its mineral resource.

HALLOYSITE-BASED PRODUCTS

Dragonite

The Company primarily markets the following four grades of halloysite-based products under the Dragonite trademark:

- Dragonite-XR
- Dragonite-HP
- Dragonite-Pure White
- Dragonite

Dragonite-XR is a halloysite-based product that is specifically formulated to act as an advanced reinforcing filler used at loading of 20 – 50 weight % in plastic composites, offering improved mechanical properties such as modulus, yield strength and HDT. We believe this product grade offers unique advantages compared to other reinforcing fillers such as glass fiber, mica, wollastonite or talc. These advantages include improvements in retention of impact resistance, elongation to break, and control over CTE and warpage in addition to a reduction in surface abrasiveness.

Dragonite-XR, when used as a synergist, can produce a flame retardance rating of up to V0 in certain polymers.

Dragonite-HP is a halloysite-based product that is specifically formulated to act as a high performance additive for engineering thermoplastics used at loadings of just 1-3 weight %. Dragonite-HP offers both an improvement in mechanical properties and cycle time reduction. This product grade offers a drop-in solution for polymer applications needing mechanical improvements without the density penalty associated with traditional fillers.

By using Dragonite-HP, customers can reduce their overall manufacturing and materials costs through cycle time improvements and thin walling.

Dragonite-Pure White is a halloysite-based product of extremely high purity that uniquely suited for cosmetic applications such as skin care, sun care, hair care and oral treatments.

Dragonite is a versatile halloysite product grade with a wide range of applications including controlled release, environmental remediation, agriculture, paints and coatings, and catalysts.

The Company is currently developing other product grades for application markets such as, but not limited to, technical ceramics, ceramic proppants, and ceramic binders.

All subsequent references to Dragonite imply all four grades.

Application Markets for Dragonite

The following is a description of the application markets to which the Company is marketing its halloysite-based Dragonite products:

Flame retardant additives for plastics. Fire retardants are widely used in flammable and flame resistant plastics and are found in electronics, building insulation, polyurethane foam, and wire and cable. There are three types of flame retardants used in plastics:

Table of Contents

- Minerals, including halloysite, aluminum trihydrate (ATH), magnesium dihydrate (MDH), glass fiber, organoclays, and a number of other less important minerals;

- Halogenated compounds. Halogenated compounds contain bromine or chlorine.

  - Halogenated flame retardants are used in conjunction with a synergist (something that enhances the effectiveness of an active agent) to enhance their efficiency. Antimony trioxide (ATO) is widely used as a synergist for halogenated fire retardants.

  - Halogenated fire retardants have been associated with health concerns due to the potential toxicity of the decomposition products, namely "Dioxins and Furans as well as environmental and bioaccumulation concerns and there has been action, in the form of treaties and federal and state legislation, to restrict certain uses of halogenated fire retardants;

- Organophosphorus compounds.

Our research and development has demonstrated that Dragonite can be used as a partial replacement for ATH and MDH in certain applications and as a synergist to ATH and MDH in other applications. At typical loadings, ATH and MDH can adversely affect certain mechanical properties of the plastics. We believe that Dragonite in conjunction with ATH and MDH, exhibits a synergistic performance.

Our research and development has demonstrated that Dragonite can be used to replace 50% - 75% of ATO in plastic without affecting flame retardancy and while retaining the same rating under UL 94, the Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing. The price of ATO has increased in recent years to $11,000 per ton. Our Dragonite product sells at a material discount to that amount.

Generally speaking, the use of Dragonite instead of other products should allow the manufacturer to use less fire retardant, which could lead to light weighting the manufactured product.

According to The Freedonia Group, world demand for flame retardant additives will be approximately 2.2 million metric tons in 2014.

Nucleation. Plastics and polymers are composed of long molecular chains which form irregular, entangled coils in the melted resin; the phase in which the resin is liquid and the molecules can move about freely.

Some plastics, namely amorphous types, retain such a disordered structure upon freezing; the state in which a liquid resin becomes solid and the molecules are frozen, or locked, in place and cannot move. In other plastics, referred to as semi-crystalline polymers, the chains rearrange upon freezing and form partly ordered regions. Examples of semi-crystalline polymers are polyethylene (PE), polypropylene (PP), nylon 6 and nylon 66.

Crystallization occurs as a result of nucleation (seeding effect), a process that starts with small, nanometer-sized domains upon which the polymer chains arrange in an orderly manner to develop larger crystals. The onset and rate of nucleation, and hence the overall rate of crystallization, among other variables, can be strongly affected by additives including impurities, dyes, plasticizers, fillers, and especially nucleating agents, in the polymer.

In plastic molding processes, especially in injection molding, the plastic part must remain in the mold until freezing. To the extent that crystallization is accelerated, the time in the mold can be reduced, thereby resulting in productivity enhancement.

Dragonite added to the resin at a 1% loading or less can speed up the process of crystallization so that the time until freezing is substantially reduced.

Additives, such as Dragonite, can affect one or more of certain mechanical properties of the polymer, such as modulus (the measure of how well a polymer resist breaking when pulled apart), strength (the measure of the stress needed to break a polymer) and impact resistance (the measure of a polymer's resistance when impacted by a sharp and sudden stress).

Dragonite at a 1% loading has the following effects on polyethylene: increase in modulus of 20% - 25%; increase in strength of 15%; and a retention of impact resistance. Dragonite at a 1% loading has the following effects on polypropylene: increase in modulus of 20-25%; increase in strength of 20%; and a retention of impact resistance. Enhanced mechanical properties provide a manufacturer with the ability to down gauge for thinner/lighter parts.

There is one competitor in the market with nucleating effectiveness comparable to Dragonite in PE and better in PP. However, those products sell for at least twice the price of Dragonite.

Thermosets and Adhesives. Published reports claim significant improvements with 1-5% Dragonite in Epoxies; polymeric material widely used in thermoset materials and adhesives, for example, impact strength improvements of the order of 300% are reported among other benefits. In adhesives based on acrylates, for example polymethylmethacrylate (PMMA), adhesive strength has been shown to improve by nearly 700%. We anticipate these property enhancements will enable Dragonite to enter into various types of thermosets and adhesives.

In 2013, one customer began selling an adhesive using Dragonite.

Reinforcement. Many plastics are reinforced allowing their use in plastics in increasingly demanding applications, where unreinforced polymers cannot perform satisfactorily. Plastics filled with particulate or fibrous fillers are classified as polymer composites. The major purpose of reinforcement is to improve the mechanical properties of the polymer. As a result of improved mechanical performance, reinforced plastics can compete with stiffer materials like metal, leading to weight reduction opportunities. Reinforcing plastics also can improve electrical properties, melt flow and viscosity, and decrease permeability within plastics.

The Company has performed tests determining flex modulus (the ratio of stress to strain in flexural deformation, or the tendency for a material to bend), tensile strength (the maximum stress that a material can withstand while being stretched or pulled before failing or breaking), flexural strength (represents the highest stress experienced within the material at its moment of rupture), and impact strength (measure the material's resistance to a sharp blow). At a 1% loading, the improvements for high-density polyethylene are a follows: an increase in flex modulus of 30%; an increase in tensile strength of 15%; an increase in flexural strength or 15% and little to no change in impact resistance. While we are not competing with conventional reinforcements such as glass fibers typically loaded at 15% - 60%, Dragonite, at a very low loading of 0.3% - 1.0%, can impart 15% - 25% improvements.

Table of Contents

Molecular Sieves and Catalysts. A molecular sieve is a material with very small holes of precise and uniform size. These holes are small enough to block large molecules while allowing small molecules to pass. Many molecular sieves are used as desiccants (substances that induce or sustain a state of dryness). Zeolites are a form of molecular sieve that are crystalline with a skeletal composed aluminosilicates. Dragonite mixes very well with zeolites and helps entrap water and impurities both within the hollow tubular structure as well as porous outer walls, enhancing drying of natural gas and air, separation of liquid from product streams, and separation of impurities from a gas stream.

Crude oil petroleum must be processed in order to make it into gasoline and other fuels. Part of that process includes cracking, whereby large hydrocarbons are broken into smaller ones. There are two general types of cracking, thermal and catalytic. Catalytic cracking involves adding a catalyst to speed up the cracking. The reactive nature of halloysite lends itself to be an effective catalyst. Halloysite can also be used as a support for catalysts, which are applied to the halloysite such as coatings that are themselves catalysts.

Halloysite from the Dragon Mine was used as a catalyst for petroleum cracking from 1949 to 1976.

Ceramics. A ceramic is any of various hard, brittle, heat-resistant and corrosion-resistant materials made by shaping and then firing a nonmetallic mineral, such as clay, at a high temperature. We intend to market our halloysite to two ceramic markets: whiteware and technical ceramics. Whiteware is a broad class of ceramic products that are white to off-white in appearance and frequently contain a significant vitreous, or glassy, component. Including products as diverse as fine china dinnerware, lavatory sinks and toilets, dental implants, and spark-plug insulators, whitewares all depend for their utility upon a relatively small set of properties: imperviousness to fluids, low conductivity of electricity, chemical inertness, and an ability to be formed into complex shapes. Examples of technical ceramics include ceramic disc brakes, missile nose cones, gas burner nozzles, and ballistic protection.

Binders.   Dragonite can be used as a binder for proppants and non-proppant ceramics.

A proppant is a solid material, typically treated sand or man-made ceramic materials, designed to keep an induced hydraulic fracture for oil or gas open during or following a fracturing treatment. It is added to a fracking fluid. A ceramic is an inorganic, nonmetallic solid prepared by the action of heat and subsequent cooling. Cerami