(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 April 2005 (21.04.2005)

PCT

(10) International Publication Number
WO 2005/035406 A1

(51) International Patent Classification[7]: B65G 53/52

(21) International Application Number:
PCT/US2004/031565

(22) International Filing Date:
27 September 2004 (27.09.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/605,467 1 October 2003 (01.10.2003) US

(71) Applicant *(for all designated States except US)*: **GENERAL ELECTRIC COMPANY** [US/US]; (a New York Corporation), 1 River Road, Schenectady, NY 12345 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **BARROR, Timothy, J.** [US/US]; 4C1 Mountain Road, Earlton, NY 12058 (US). **MOORE, Patrick, S.** [US/US]; 20 Hobbie Lane, Selkirk, NY 12158 (US).

(74) Agents: **WINTER, Catherine, J.** et al.; Patent Counsel, General Electric Company, 3135 Easton Turnpike (W3C), Fairfield, CT 06828 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD FOR TRANSPORTING PLASTIC PELLETS

(57) Abstract: A method for transporting plastic pellets comprising blowing plastic pellets through a conduit from an inlet to an outlet wherein the conduit has an inner surface with sufficient topography to cause the plastic pellets to tumble, such that the pellets do not smear on the inside surfaces of the transfer line.

WO 2005/035406 A1

METHOD FOR TRANSPORTING PLASTIC PELLETS

BACKGROUND OF THE INVENTION

The dispersed phase transfer method for plastic pellets includes conveying the pellets by blowing the pellets from an extruder through a transport pipe into a container such as a holding bin. When plastic pellets such as pellets formed from polyphenylene ether resin, are ejected from an extruder into the transport pipe, the pellets are floating in an air medium, and tend to drag against the walls of the transport pipe, causing friction that tends to smear the pellets. The smeared resin forms a "skin" and/or "strings" on the inside surfaces of the transfer line. The skin and/or strings can be sloughed off of the transfer pipe surface by new pellets traveling down the line, with the result that skins and/or strings end up in the product. Production must sometimes be shut down in order to wash the transfer lines, resulting in a delay in production. In addition, skins and/or strings may clog filters on dryers and molding machines.

Thus, a need exists for new methods for transporting plastic pellets without smearing the pellets.

BRIEF DESCRIPTION OF THE INVENTION

Disclosed herein are a system and method for transporting plastic pellets. In one embodiment the method for transporting plastic pellets comprises: moving plastic pellets through a conduit from an inlet to an outlet, wherein the conduit has an inner surface having sufficient topography to cause the plastic pellets to tumble.

The above described and other features are exemplified by the following detailed description.

DETAILED DESCRIPTION OF THE INVENTION

Disclosed herein is a method for transporting plastic pellets through a tubular pipe, preferably reducing or eliminating the smearing of the pellets, thereby reducing or eliminating the formation of "skin" and/or "strings" on the inside surfaces of the transfer line, and reducing the occurrence of skins in the product. This method

reduces or eliminates the possibility of skins from previous grades getting into a new grade of plastic pellet moved through the same tubular pipe.

The method includes moving (e.g., by use of a vacuum system, suction, ejecting, blowing, and/or expelling) the plastic pellets through a conduit (e.g., a pipe) having an inner surface topography comprising a groove, thread, protuberance, indentation or combinations of two or more of the foregoing thus enabling the pellets to move through the pipe without forming skins and/or strings. For example, the conduit may have a substantially cylindrical body, wherein the cylindrical body defines a channel having an inlet, an outlet, and an inner surface, with a spiral geometry (e.g., groove(s), thread(s), indentations and/or protuberances) formed on (e.g., on/into) at least a portion of the inner surface. The pellets move through the channel from the inlet to the outlet. Alternatively, the grooves, thread and/or protuberances may be randomly arranged or arranged in a non-spiral ordered fashion such as concentrically.

The width of the grooves or indentations, or the height of the threads or protuberances on the inner surface of the conduit may be any sufficient depth or height, respectively, as well as any pitch and frequency, to attain the desired motion of the pellets through the conduit such that smear and the formation of skins and strings is avoided. The width of the grooves or indentations or the height of the threads or protuberances as well as spacing between the groove, indentations, threads and/or protuberances should be sufficient to cause the majority of the pellets to tumble without resulting in accumulation or blockage. In some embodiments the width of the grooves or indentations or the height of the threads or protuberances is about 0.79 to 3.17 millimeters. The width of the grooves or indentations or the height of the threads or protuberances may vary throughout the length of the conduit. In one embodiment, the width of the grooves or indentations or the height of the threads or protuberances is about 10 to about 100 percent, preferably about 20 to about 50 percent, of the longest average linear dimension of the pellet.

Preferably the transported pellets comprises less than or equal to about 0.5 weight percent, more preferably less than or equal to about 0.3 weight percent, and most

preferably less than or equal to about 0.3 weight percent skins and strings based on the total weight of the transported pellets.

The design of the geometry (e.g., the depth and arrangement of the grooves and/or indentations, the height and arrangement of the threads and/or protuberances) is sufficient to cause the pellets to tumble rather than slide, thereby reducing friction and enabling a decreased amount of sliding movement of the pellets through the conduit, including bends and elbows therein. While not being limited by theory, it is hypothesized that heat created by the friction from pellets sliding along the inside surface of the channel is responsible, at least in part, for pellets smearing. Creation of a tumbling motion reduces or eliminates the amount of friction, thereby reducing or eliminating pellet smearing.

The specific dimensions of the conduit and the design of the geometry are sufficient for the particular application (e.g., pellet flow rate, etc.). For example, an inner conduit diameter may be about 1 inch (about 2.54 centimeters (cm)) to about 10 inches (about 25.4 cm), with a diameter of about 4 inches (about 10.2 cm) to about 6 inches (about 15.2 cm) possible. The length of the pipe can be any length suitable for use in a transfer system capable of forcing the pellets through the length of pipe, e.g., the length can be up to and exceeding 50 feet, with a conduit length of about 80 feet to about 200 feet common for use with this process.

The conduit may comprise a material compatible with the particular pellet and having sufficient structural integrity and durability. Possible materials include metals (such as stainless steel, copper, aluminum, and the like, as well as combinations and alloys comprising at least one of the foregoing metals). The piping may be rigid or flexible. As the term is used herein, "rigid" refers to a material that is not bent or deformed as the pellets are transferred through the pipe. As the term is used herein, "flexible" refers to a material that can bend or be deformed as the pellets are transferred through the pipe.

The conduit geometry and design is based upon the particular application. For example, the conduit can be substantially cylindrical, and can be straight or can

comprise straight, curved, and/or elbow portions (e.g., turns in the conduit that can up to a 90° bend in the conduit). It is preferable that the grooves, threads, indentations and/or protuberances be disposed throughout the conduit from the inlet, through any bends, elbows, and/or curves, to the outlet. By "substantially cylindrical" is meant that the tube body does not have constrictions or increases in diameter that would affect the movement of pellets through the non-straight portions.

The term "pellet" as used herein refers to particles that are larger than "powders". By way of illustration, the pellets may have at least one dimension that is greater than or equal to about 0.5 millimeter to about 5 millimeters. Possible pellets include pelletized extrudate, e.g., blown from an extruder through the conduit to a storage or other area.

The method has been found particularly useful with plastic pellets having a scratch resistance, as measured in scratch depth, of about 800 micrometers to about 7,000 micrometers. The plastic pellets comprise a thermoplastic resin such as poly(arylene ether), polyamides, polyimides (e.g., polyetherimide, and the like), polystyrenes, polycarbonates, and the like, as well as combinations and reaction products comprising at least one of the foregoing resins, such as poly(arylene ether)/polyamide compatibilized blends, poly(arylene ether)/polystyrene blends, and polycarbonate blends. In one embodiment the plastic pellets comprise poly(arylene ether) and less than or equal to about 5 weight percent polyolefin based on the total weight of the composition. A typical plastic pellet suitable for use in the disclosed method is Noryl GTX® resin (GE Plastics).

In order to further reduce the potential formation of skins and strings as well as to inhibit smear, the conduit temperature can be maintained below the softening point of the pellet. For example, the temperature can be maintained at a temperature of less than or equal to about 170°C, with less than or equal to about 160°C preferred. In operation, the temperature of the conduit can be maintained at about 100°C to about 170°C, with about 100°C to about 130°C preferably employed throughout the conduit. To help insure the integrity of the pellets, maintenance of the temperature at less than or equal to about 50°C below the glass transition temperature of the pellet is preferred.

EXAMPLES

Plastic pellets were moved through a pipe having a smooth internal surface (smooth) or a spiral groove on the internal surface (spiral) with a terminal velocity of 1829 meters/minute. The plastic pellets had an average longest linear dimension of about 3.17 millimeters. The groove in the pipe had a width of about 0.79 to 3.17 millimeters. The composition of the plastic pellets as well as the presence or absence of skins and strings is shown in Table 1.

Table 1

Pellet Composition	Smooth conduit	Spiral conduit
Poly(arylene ether)/polyamide blend	Skin	No skin
Poly(arylene ether)/polypropylene blend	Skin	Skin

Conduits having the interior spiral geometry substantially reduced skins and strings therein during the transfer of pellets. This system and method prevents or minimizes a condition of abraded plastic material buildup in the form of skins or strings in conduits (e.g., pipes) used to transport the pellets, and also reduces or eliminates contamination of the product with skins or strings. The method enables transport of plastic pellets without stoppage of pellet flow for cleaning the transfer lines, and with minimal maintenance of the transfer lines and equipment. This enables the pellets to be continuously moved through the channel from the inlet to the outlet.

While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular

situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

CLAIMS

1. A method for transporting plastic pellets comprising moving plastic pellets through a conduit from an inlet to an outlet wherein the conduit has an inner surface with sufficient topography to cause the plastic pellets to tumble.

2. The method of Claim 1 wherein the topography comprises a groove, thread, protuberance, indentation, or combination of two or more of the foregoing.

3. The method of Claim 2 wherein the groove, thread, protuberance, indentation, or combination of two or more of the foregoing is arranged in a spiral geometry.

4. The method of Claim 2 wherein the groove, thread, protuberance, indentation, or combination of two or more of the foregoing is randomly arranged.

5. The method of Claim 2 wherein the groove, thread, protuberance, indentation, or combination of two or more of the foregoing is arranged in a non-spiral ordered fashion.

6. The method of Claim 2 wherein the groove and/or indentation has a width that is about 10 to about 50 percent of the longest average linear dimension of the plastic pellets.

7. The method of Claim 2 wherein the thread and/or protuberance has a height that is about 10 to about 50 percent of the longest average linear dimension of the plastic pellets.

8. The method of Claim 1 wherein the transported pellets comprise less than or equal to about 0.5 weight percent skins and strings based on the total weight of the transported pellets.

9. The method of Claim 1 wherein the conduit comprises a metal.

10. The method of Claim 1 wherein the conduit is rigid.

11. The method of Claim 1 wherein the conduit is flexible.

12. The method of Claim 1 wherein the plastic pellets comprise poly(arylene ether), polyamide, polyimide, polystyrene, polycarbonate and combinations of two or more of the foregoing resin.

13. The method of Claim 1 wherein the conduit is maintained at a temperature of about 100 to about 170°C.

14. The method of Claim 1 wherein the conduit is maintained at a temperature less than or equal to about 50°C below the glass transition temperature of the plastic pellet.

15. A method for transporting plastic pellets comprises: moving pellets comprising poly(arylene ether) and polyamide through a conduit from an inlet to an outlet, wherein the conduit has an inner surface comprising a groove, thread, protuberance, indentation or combination of two or more of the foregoing and the transported pellets contain less than or equal to about 0.5 weight percent skins and strings, based on the total weight of the transported pellets.

INTERNATIONAL SEARCH REPORT

International Application No
..:/US2004/031565

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65G53/52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65G F15D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 0 377 979 A (BP CHEM INT LTD) 18 July 1990 (1990-07-18) column 2, line 13 - column 5, line 54; figures	1,2,5-8, 12-15 3,4,9,10
Y	GB 2 213 792 A (WAESCHLE MASCHF GMBH) 23 August 1989 (1989-08-23) figures 1-3	3,9,10
Y	CH 587 171 A (NAGEL HEINRICH) 29 April 1977 (1977-04-29) figures 4a,4b	4
A	US 3 224 814 A (DONALD FISHER CHESTER) 21 December 1965 (1965-12-21) the whole document	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 November 2004	07/12/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lawder, M

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International Application No
. .T/US2004/031565

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 464 740 A (MCIVER DONALD J ET AL) 2 September 1969 (1969-09-02) the whole document -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
../US2004/031565

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0377979	A	18-07-1990	FR	2641263 A1	06-07-1990
			EP	0377979 A1	18-07-1990
			JP	2225217 A	07-09-1990
			US	5020943 A	04-06-1991
			US	5054966 A	08-10-1991
GB 2213792	A	23-08-1989	DE	8717367 U1	29-09-1988
			FR	2624489 A1	16-06-1989
			IT	1227516 B	12-04-1991
			JP	1199084 A	10-08-1989
			NL	8803002 A	03-07-1989
CH 587171	A	29-04-1977	CH	587171 A5	29-04-1977
US 3224814	A	21-12-1965	NONE		
US 3464740	A	02-09-1969	NONE		