(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 077 258 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.07.2009 Bulletin 2009/28

(21) Application number: **08021221.0**

(22) Date of filing: **05.12.2008**

(51) Int Cl.:
C06B 31/28 *(2006.01)* ***C06D 5/06*** *(2006.01)*
C06B 45/00 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(30) Priority: **11.12.2007 JP 2007319125**

(71) Applicant: **Daicel Chemical Industries, Ltd.**
Kita-ku
Osaka-shi
Osaka 530-0001 (JP)

(72) Inventors:
- **Ohji, Nobuyuki**
  Tatsuno-shi
  Hyogo (JP)
- **Kobayashi, Shoji**
  Tatsuno-shi
  Hyogo (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Anwaltssozietät
Leopoldstrasse 4
80802 München (DE)

(54) Gelatinous enhancer for inflator

(57) The present invention relates to a gelatinous enhancer for an inflator, including silicone oil and ammonium nitrate.

EP 2 077 258 A1

Description

BACKGROUND OF INVENTION

Field of Invention

[0001] The present invention relates to a gelatinous enhancer for an inflator, which is used in an inflator for an air bag apparatus or other applications.

Description of Arts

[0002] B/KNO_3 is widely employed as a enhancer for an inflator. B/KNO_3 has a high combustion temperature and favorable ignitability in relation to a gas generant. However, B/KNO_3 burns vigorously, and therefore burns out instantaneously. Hence, B/KNO_3 is insufficient as a enhancer for a gas generant having low ignitability. Furthermore, B/KNO_3 is expensive and exhibits a low gas efficiency.

[0003] Further, when B/KNO_3 is used, a problem arises in that an abnormal noise occurs during an operation. This problem can be solved by employing a elastic enhancer, but an elastic enhancer is easily affected by the environmental temperature and is therefore unsatisfactory in terms of operational reliability over a wide temperature range (-40°C to 105°C). US-A No .2005/0235863, JP-A No. 2000-8637 and JP-A No. 2002-12493 are in the state of arts.

SUMMARY OF INVENITON

[0004] An invention relates to a gelatinous enhancer for an inflator, including silicone oil and ammonium nitrate.

DETAILED DESCRIPTION OF INVENTION

[0005] The present invention provides a gelatinous enhancer for an inflator, which can solve problems relating to costs, ignitability in relation to a gas generant, and so on.

[0006] The invention preferably relates to a gelatinous enhancer for an inflator, wherein the silicone oil content ranges from 5 to 35 mass% and the ammonium nitrate content ranges from 65 to 95 mass%.

[0007] The gelatinous enhancer for an inflator according to the present invention generates more combustion heat than B/KNO_3 which is widely used as a enhancer, and therefore exhibits favorable ignitability in relation to a gas generant having low ignitability. Further, the gas efficiency of the gelatinous enhancer for an inflator according to the present invention is high, and therefore gas generated thereby can be used also to inflate an air bag. Thus, gas generated from the gas generant can be complemented by the gas generated by the gelatinous enhancer.

Preferred Embodiment of Invention

[0008] Known silicone oil is used in the present invention (see [0016] to [0019] of US-A No .2005/0235863, for example), and either straight silicone oil or denatured silicone oil may be used. However, straight silicone oil (polydimethylsiloxane, for example) is preferable.

[0009] To provide the enhancer in a gelatinous form, the viscosity of the silicone oil is preferably within a range of 100 to 20, $000cm^2/s$, more preferably within a range of 500 to 15, $000cm^2/s$, and even more preferably within a range of 1000 to 15, $000cm^2/s$ The method of measuring the viscosity corresponds to the method described in JIS K2283, and a value measured at 25°C is taken.

[0010] The silicone oil content is preferably between 3 and 30 mass%, more preferably between 5 and 25 mass%, and even more preferably between 5 and 20 mass%.

[0011] Ammonium nitrate used in the present invention may be a normal ammonium nitrate or an ammonium nitrate subjected to phase stabilization by a known method (for example, JP-A No. 2002-338241, JP-A No. 2006-520312, JP-A No. 10-259085) using potassium nitrate, an inorganic potassium salt such as potassium perchlorate, an organic potassium salt such as potassium oxalate, or the like.

[0012] The ammonium nitrate content is preferably between 70 and 97 mass%, more preferably between 75 and 95 mass%, and even more preferably between 80 and 95 mass%.

[0013] The gelatinous enhancer for an inflator according to the present invention may be a three component-based enhancer including a nitrogen-containing compound in addition to the silicone oil and ammonium nitrate described above. When a nitrogen-containing compound is included, the gas efficiency (mol/100g; expressing the number of moles of gas generated per 100g of gas generant) increases and an initial pressure upon ignition increases, preferably leading to an improvement in ignitability in relation to the gas generant.

[0014] When a nitrogen-containing compound is included, the nitrogen-containing compound content is preferably 30 mass% or less of the total amount of the ammonium nitrate and the nitrogen-containing compound.

[0015] The nitrogen-containing compound may be selected from a tetrazole derivative, guanidine, guanidine carbonate, nitroguanidine, dicyandiamide, nitroaminoguanidine, and nitroaminoguanidine nitrate.

[0016] Examples of tetrazole derivatives include tetrazole, 5-aminotetrazole, 5,5'-bi-1H-tetrazole, 5-nitroaminotetrazole, 5-aminotetrazole zinc salt, 5-aminotetrazole copper salt, bitetrazole, bitetrazole potassium salt, bitetrazole sodium salt, bitetrazole magnesium salt, bitetrazole calcium salt, bitetrazole diammonium salt, bitetrazole copper salt, and bitetrazole melamine salt.

[0017] The gelatinous enhancer for an inflator according to the present invention can be obtained by blending a predetermined amount of silicone oil, a predetermined amount of ammonium nitrate, and in certain cases, a predetermined amount of a nitrogen-containing compound.

[0018] The gelatinous enhancer for an inflator according to the present invention can be applied to various types of inflators having a known gas generant, for example an inflator for an air bag used in a driver side, an inflator for an air bag for a front passenger side, an inflator for a side air bag, an inflator for an inflatable curtain, an inflator for a knee bolster, an inflator for an inflatable seatbelt, an inflator for a tubular system, and an inflator for a pretensioner of various types of vehicles.

Examples

[0019] Examples and Comparative Example

[0020] By blending the components shown in Table 1, a gelatinous enhancer for an inflator according to Examples and a enhancer according to Comparative Example were obtained. The following tests were performed on these enhancers. The results are shown in Table 1.

(1) Combustion temperature (K)
A simulation value based on a thermochemical equilibrium calculation program.
(2) Combustion heat (cal/g)
A simulation value based on a thermochemical equilibrium calculation program.
(3) Gas efficiency (mol/100g)
A simulation value based on a thermochemical equilibrium calculation program.
(4) Friction sensitivity (N), drop hammer sensitivity (cm)
The friction sensitivity (N) and the drop hammer sensitivity (cm) were measured on the basis of an explosive performance test method described in JIS K4810-1979.

Table 1

	Gas generant composition (mass%)	Combustion temperature (K)	Combustion heat(cal/g)	Gas efficiency (mol/100g)	Friction sensitivity (N)	Drop hammer sensitivity (cm)
Example 1	Silicone oil (1)/ Ammonium nitrate= 10.4/89.6	2393	1191	4.06	>353	50-60
Example 2	Silicone oil (2)/ Ammonium nitrate= 10.4/89.6	2393	1191	4.06	>353	50-60
Example 3	Silicone oil (3)/ Ammonium nitrate= 10.4/89.6	2393	1191	4.06	>353	50-60

(continued)

	Gas generant composition (mass%)	Combustion temperature (K)	Combustion heat(cal/g)	Gas efficiency (mol/100g)	Friction sensitivity (N)	Drop hammer sensitivity (cm)
Comparative Example 1	B/KNO_3= 25/75	3089	827	1.34	>353	30-40

[0021] Ammonium nitrate: product name K-320 (manufactured by Sumitomo Chemical Co., Ltd.)

[0022] Silicone oil (1): product name TSF451-30M (manufactured by Momentive Performance Materials Japan LLC.), viscosity 3000cm^2/s

[0023] Silicone oil (2): product name KF-96 (manufactured by Shin-Etsu Chemicals Co., Ltd.), viscosity 5,000cmcm^2/s Silicone oil (3): product name KF-96H (manufactured by Shin-Etsu Chemicals Co., Ltd.), viscosity 10,000cm^2/s

Claims

1. A gelatinous enhancer for an inflator, comprising silicone oil and ammonium nitrate.

2. The gelatinous enhancer according to claim 1, wherein the silicone oil content ranges from 5 to 35 mass% and the ammonium nitrate content ranges from 65 to 95 mass%.

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 08 02 1221

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 999 744 A (ECKELS WARREN H) 12 September 1961 (1961-09-12) * column 8, line 16 - line 22; claims *	1,2	INV. C06B31/28 C06D5/06 C06B45/00
X	WO 01/19757 A (AUTOMOTIVE SYSTEMS LAB [US]) 22 March 2001 (2001-03-22) * page 3, line 11 - page 4, line 28; claims; examples 8-11,13,20 *	1	
Y	EP 1 000 916 A (DAICEL CHEM [JP]) 17 May 2000 (2000-05-17) * page 3, line 58 - page 4, line 8; claims *	1,2	
Y	EP 0 950 647 A (DAICEL CHEM [JP]) 20 October 1999 (1999-10-20) * page 4, line 17 - line 26; claims *	1,2	
X	WO 2005/072401 A (AUTOMOTIVE SYSTEMS LAB [US]) 11 August 2005 (2005-08-11) * page 5, last paragraph; claims *	1	TECHNICAL FIELDS SEARCHED (IPC)
X	WO 2005/072432 A (AUTOMOTIVE SYSTEMS LAB [US]) 11 August 2005 (2005-08-11) * page 6, last paragraph; claims *	1	C06B C06D
D,X	& US 2005/235863 A1 (STEVENS BRUCE A [US]) 27 October 2005 (2005-10-27)	1	
A	US 3 113 894 A (BURTON JOE M) 10 December 1963 (1963-12-10) * column 5, line 16 - line 52; claims *	1,2	
A	DE 20 27 709 A1 (DYNAMIT NOBEL AG, 5210 TROISDORF) 9 December 1971 (1971-12-09) * claims *	1,2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 April 2009	Schut, Robert

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 02 1221

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-04-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2999744 A	12-09-1961	NONE	
WO 0119757 A	22-03-2001	EP 1377534 A2	07-01-2004
		JP 2003529515 T	07-10-2003
EP 1000916 A	17-05-2000	CN 1266416 A	13-09-2000
		WO 9957083 A1	11-11-1999
		TW 440556 B	16-06-2001
EP 0950647 A	20-10-1999	CN 1236767 A	01-12-1999
		DE 69906617 D1	15-05-2003
		DE 69906617 T2	06-11-2003
		JP 11292678 A	26-10-1999
		TW 530037 B	01-05-2003
		US 6468369 B1	22-10-2002
WO 2005072401 A	11-08-2005	EP 1727776 A2	06-12-2006
		JP 2007523036 T	16-08-2007
		US 2005161135 A1	28-07-2005
WO 2005072432 A	11-08-2005	EP 1789372 A2	30-05-2007
		JP 2007519602 T	19-07-2007
US 2005235863 A1	27-10-2005	NONE	
US 3113894 A	10-12-1963	NONE	
DE 2027709 A1	09-12-1971	SE 388601 B	11-10-1976

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20050235863 A **[0003] [0008]**
- JP 2000008637 A **[0003]**
- JP 2002012493 A **[0003]**
- JP 2002338241 A **[0011]**
- JP 2006520312 A **[0011]**
- JP 10259085 A **[0011]**