<table>
<thead>
<tr>
<th>1.0</th>
<th>1.1</th>
<th>1.2</th>
<th>1.4</th>
<th>1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>2.2</td>
<td>2.5</td>
<td>2.8</td>
<td>3.0</td>
</tr>
</tbody>
</table>
INSTRUCTIONS
(a) If Convention application insert "Convention"

(b) Delete one

(c) Insert FULL name(s) of applicant(s)

(d) Insert FULL address(es) of applicant(s)

(e) Delete one

(f) Insert TITLE of invention

(g) Insert "complete" OR "provisional" OR "petty patent" 

(h) Insert number, country and filing date for the/or EACH basic application

(i) Insert DATE of signing

(j) Signature of applicant(s) 
   (For body corporate see headnote*)

(k) Corporate seal if any

Note: No legalization or other witness required

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

Dated on 30 July, 1980

SNAMPROGETTI S.p.A.
By its Patent Attorneys:
PHILLIPS ORMONDE AND FITZPATRICK

Address for Service:

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

INSTRUCTIONS
(a) If Convention application insert "Convention"

(b) Delete one

(c) Insert FULL name(s) of applicant(s)

(d) Insert FULL address(es) of applicant(s)

(e) Delete one

(f) Insert TITLE of invention

(g) Insert "complete" OR "provisional" OR "petty patent" 

(h) Insert number, country and filing date for the/or EACH basic application

(i) Insert DATE of signing

(j) Signature of applicant(s) 
   (For body corporate see headnote*)

(k) Corporate seal if any

Note: No legalization or other witness required

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

Dated on 30 July, 1980

SNAMPROGETTI S.p.A.
By its Patent Attorneys:
PHILLIPS ORMONDE AND FITZPATRICK

Address for Service:

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

Dated on 30 July, 1980

SNAMPROGETTI S.p.A.
By its Patent Attorneys:
PHILLIPS ORMONDE AND FITZPATRICK

Address for Service:

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

Dated on 30 July, 1980

SNAMPROGETTI S.p.A.
By its Patent Attorneys:
PHILLIPS ORMONDE AND FITZPATRICK

Address for Service:
COMMONWEALTH OF AUSTRALIA

Patents Act

DECLARATION FOR A PATENT APPLICATION

In support of the "Convention" application made by

(1) Snamprogetti S.p.A.,

(thereinafter called "applicant(s)") for a patent for an invention entitled "Process for setting the explosion-proneness of the gases exiting urea-production installations."

I/We (a) Carlo SICHT, proxy of Snamprogetti S.p.A., of Corso Venezia 16, Milan, Italy.

(b) 61159/80

do solemnly and sincerely declare as follows:

1. I am/We are the applicant(s).
2. I am/We are the actual inventor(s) of the invention.
3. The basic application(s) for patent or similar protection on which the application is based is/are identified by country, filing date, and basic applicant(s) as follows:

   Italy, 17 October, 1979, SNAMPROGETTI S.p.A.

4. The basic application(s) referred to in paragraph 3 hereof was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at (b) MILAN
Dated (c) 30 July, 1980
SNAMPROGETTI S.p.A.

To: The Commissioner of Patents

PHILLIPS ORMONDE & FITZPATRICK
Patent and Trade Mark Attorneys
1. A process for suppressing the explosibility of the discharge gases from urea-producing installations, characterized in that said discharge gases are admixed with one or more of the gas streams which are available in ammonia-producing installations, having as its constituents $\text{H}_2$ from 0.1% to 77% by volume, $\text{N}_2$ from 0.1% to 29% by volume, CO and/or $\text{CO}_2$ and/or Ar and/or He from 0.1% to 50% by volume, and methane to balance 100% by volume.
AUSTRALIA

Patents Act

COMPLETE SPECIFICATION
(ORIGINAL)

Class Int. Class

Application Number:

Lodged:

Complete Specification Lodged:

Accepted:

Published:

Priority:

Related Art:

APPLICANT'S REF.: CASE: 1258

Name(s) of Applicant(s): SNAMPROGETTI S.p.A.

Address(es) or Applicant(s): Corso Venezia 16,
Milan, Italy.

Actual Inventor(s): Vincenzo LAGANA
Francesco SAVIANO
Virginio CAVALANII

Address for Service is: PHILLIPS, ORMONDE & FITZPATRICK
Patent and Trade Mark Attorneys
367, Collins Street
Melbourne, Australia, 3000

Complete Specification for the invention entitled:

"Process for offsetting the explosion-proneness of the gases
exiting urea-production installations."

The following statement is a full description of this invention, including the best method of performing it known to
applicant(s):
This invention relates to a process for suppressing the proneness to explosion of discharge gases from urea-producing installations. As is known, urea is produced starting from ammonia and carbon dioxide by direct synthesis in a reactor working under a high pressure (from 50 atm to 450 atm) and at a high temperature (from 170°C to 220°C).

The reaction product, which is composed by urea, ammonium carbamate and water, exits the reactor together with the ammonia which has been used in excess for the reaction and is fed to a decomposer: the latter operates substantially under the same pressure as that used for the synthesis and, in such a high-pressure decomposer, the carbamate contained in the urea solution is decomposed into ammonia and carbon dioxide.

The ammonia and the carbon dioxide derived from the decomposition are fed to a high-pressure condenser which operates substantially under the same pressure as used for the synthesis: in such condenser, ammonia and carbon dioxide are condensed so as to form ammonium carbamate again, to be recycled to the urea-synthesis reactor.

The solution of urea, stripped of the predominant
fraction of the carbamate, is dumped from the high-pressure decomposer and is fed to a medium-pressure decomposer, whereina further fraction of the carbamate is decomposed into ammonia and carbon dioxide: these latter are condensed within a condenser under a pressure which is substantially the same as that obtaining in the medium-pressure decomposer (medium-pressure, as indicated herein, is understood as ranging from 25 atm to 10 atm, 18 atm being preferred): the major fraction of the condensable products are condensed in such decomposer.

From the medium-pressure condenser, the stream of condensates and uncondensed products, to be better defined as the present specification proceeds, is fed to a rectification column: from the top of the column, pure ammonia and uncondensable products are obtained, whereas from the column bottom, a stream of ammonium carbonate is discharged, to be recycled to the high-pressure carbamate condenser; the ammonia, as recovered from the rectification, is likewise recycled to the synthesis.

The reactants to be fed to the reactor contain a certain portion of dissolved gases: these latter come from the ammonia-production installation and from the CO₂-producing unit as well, and are essentially composed by H₂, N₂, CO, CH₄, Ar and He.

To the urea installation, to the reactor and to the decomposer, are fed certain volumes of air or of oxygen in order to protect the decomposer, the condenser and the reactor against the corrosive action of ammonium carba-
All the uncondensable gases mentioned above, both those which were originally contained in the fresh stream of CO₂ and ammonia, and those introduced for providing a passive protection for the units exposed to corrosion, are discharged from the urea-synthesis installation and, after having been stripped of the accompanying saturation ammonia, form an explosive mixture, on account of the presence of the oxygen which had been employed for said passive protection.

The gases in question are generally discharged, partly from the high-pressure carbamate condenser, wherefrom they are preferably forwarded to the medium-pressure rectification column for recovering ammonia and become admixed, in that column, with the stream coming from the medium-pressure carbamate condenser.

In the ammonia-recovery column aforementioned, ammonia is recovered at the top together with the gases in question and, upon condensation of the ammonia, these gases, stripped of ammonia, are discharged and make up the explosive stream aforesaid.

It is apparent that the stream of uncondensable gases, which is explosive, might also be drawn from other points of the installation without thereby modifying the problem in any way.

The expedient which has heretofore been commonly adopted to prevent the explosion of such a mixture has been that of admixing the explosive gas stream with such
a volume of incombustible gases as to bring the composition of the resultant gaseous mixture beyond the explosibility limits.

It has been found, now, that the proneness to explosion of the mixture of discharge gases from urea-producing installations can be done away with, but without diluting such a mixture with incombustible gases and thus without depressing its combustibility: this result can be achieved by exploiting the streams from the ammonia-synthesis installation, which are currently available in urea-synthesis plants.

In ammonia-synthesis, the following streams are available in particular:

1. Natural-gas stream, essentially composed by methane. This stream is sent to the steam-reforming for the production of the ammonia-synthesis gas.

2. Gas stream coming from steam-reforming, essentially composed by H₂, N₂, CO and CO₂.

3. Gas stream coming from steam-reforming, but stripped of CO₂.

4. Stream of nitrogen and hydrogen, saturated with ammonia and possibly with water, which contains Ar, He and CH₄, as discharged from the ammonia-production unit in order to offset the enrichment of the stream to be sent back to the ammonia-synthesis with argon, helium and methane.

The typical composition ranges of the streams aforesaid is as follows:
An objective of the present invention is to provide a process for suppressing the explosibility of the discharge gas from urea-producing installation, said process comprising the step of admixing said discharge gases with one or more of the streams which are available in installations for the production of ammonia, having the composition:

- $H_2$ from 0.1% to 77% by volume
- $N_2$ from 0.1% to 29% by volume
- Inert gases (CO + CO$_2$ + Ar + He) from 0.1% to 50% by volume
- CH$_4$ balance to 100% by volume

In the streams listed above under Nos. 2, 3 and 4, the molar ratio between $H_2$ and $N_2$ is comprised, moreover, between 2.5 and 3.3.

Indeed a surprising fact is that, by operating in accordance with this invention, the proneness to explosion is suppressed not only due to the change of the composition of the mixture, but also, quite unpredictably, on account of a narrowing of the explosibility zone.

It has thus become possible, when operating in accordance with the invention, not only to render non-explosive the gas stream of uncondensable gases from the urea installation, but also to make possible to exploit
the mixture as a gaseous fuel in the installation.

An example will now be given for better illustrating the invention, which is not intended to be limited thereby.

**EXAMPLE**

Reference will be had to the diagram of FIGURE 1 of the accompanying drawings, which is a simplified showing of a urea-producing installation. Assuming that the installation in question has an average output of 1500 metric tons of urea daily, the volume of the gases dissolved in the reactants is 410 normal m$^3$ hourly, and the composition is as follows:

- $\text{H}_2 \quad 51.47\%$ on a volume basis
- $\text{N}_2 \quad 40.73\%$
- $\text{O}_2 \quad 7.56\%$
- $\text{CO} \quad 0.12\%$
- $\text{CH}_4 \quad 0.12\%$

The high-pressure decomposer receives 333 normal m$^3$ of passivation air hourly.

All these gases are evolved from the reaction solution and are drawn out of the installation through the top of the ammonia-rectification column; the latter operates at about 18 atm. The head gases of this column, 12, after an initial condensation of the predominant fraction of ammonia in the exchanger 8, are separated from such ammonia in the separator 1, and the thusly separated ammonia is drawn, via the line 9 and exploited in other units of the installation. The gases, saturated with ammonia at the temperature of the separator 1 (35°C) have the following
and must be sent via the line 2 to the absorber 6, where-in ammonia is recovered by having it absorbed with the water which comes through the line 7.

By stripping this gas of its ammonia, a gaseous mixture is obtained, which has the following composition:

Flammable gas 28.54% by volume, of which: $H_2 = 28.40\%$

[Other components and their percentages are listed here.]

As can be seen in the plot of FIGURE 2, which shows the explosibility limits of the gas, the representative point for the gas, D, is in the interior of the explosibility area: in the triangular diagram, A = 100% of $O_2$, B = 100% of inert gases, and C = 100% of flammable gases.

Conversely, when operating in accordance with this invention, the gases of the line 2 are admixed at 11 with the discharge gases of the ammonia synthesis cycle (production of ammonia = 865 metric tons daily) which come through the line 3: these gases have the following rate of flow and composition:
8.

Rate of flow 7633 normal $m^3$ hourly

Composition

\[
\begin{align*}
H_2 &= 54.86\% \\
CH_4 &= 10.92\% \\
N_2 &= 21.94\% \\
NH_3 &= 12.28\% \\
\end{align*}
\]

100.00\% by volume

The gas mixture which is sent via the pipe 4 to the absorber 6 has the following composition:

\[
\begin{align*}
H_2 &= 4398.0 \\nCH_4 &= 833.5 \\nCO &= 0.5 \\N_2 + Ar &= 2105.0 \\
O_2 &= 110.0 \\
NH_3 &= 3914.0
\end{align*}
\]

11352.0 normal $m^3$ hourly

Upon ammonia stripping, the gas will have the following composition:

\[
\begin{align*}
H_2 &= 59.14\% \text{ by volume} \\
CH_4 &= 11.21\% \\
N_2 + Ar &= 28.30\% \\
O_2 &= 1.35\%
\end{align*}
\]

Total inflammable gas 70.35\% by volume

The plot of FIGURE 3, which is quite similar to that of FIGURE 2, indicates the limits of explosibility of this latter gas mixture, and its representative point, D, is widely beyond those limits. A, B, and C have the same meanings as in FIGURE 2.
The claims defining the invention are as follows:

1. A process for suppressing the explosibility of the discharge gases from urea-producing installations, characterized in that said discharge gases are admixed with one or more of the gas streams which are available in ammonia-producing installations, having as its constituents $H_2$ from 0.1% to 77% by volume, $N_2$ from 0.1% to 29% by volume, CO and/or $CO_2$ and/or Ar and/or He from 0.1% to 50% by volume, and methane to balance 100% by volume.

2. A process according to claim 1, wherein the stream available in ammonia-synthesis installations is a member selected from the group consisting of:
   a) natural-gas stream, essentially composed by methane,
   b) a stream coming from steam-reforming of methane, essentially composed by $H_2$, $N_2$, CO and $CO_2$,
   c) gas stream coming from steam reforming, stripped of $CO_2$, and
   d) an ammonia-saturated nitrogen and hydrogen stream, possibly saturated also with water and containing Ar, He and $CH_4$, as vented out of the ammonia-producing unit.


SNAMPROGETTI S.p.A.
By its Patent Attorneys:
PHILLIPS ORMONDE AND FITZPATRICK