

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199743597 B2
(10) Patent No. 734562

(54) Title
Synthesis clean gas

(51)⁶ International Patent Classification(s)
B01D 053/047 F23G 005/00
B09B 003/00 F25J 003/08

(21) Application No: 199743597

(22) Application Date: 1997 .10 .29

(30) Priority Data

(31) Number (32) Date
19644964 1996 .10 .29
19734488 1997 .08 .08

(33) Country
DE
DE

(43) Publication Date : 1998 .05 .07

(43) Publication Journal Date : 1998 .05 .07

(44) Accepted Journal Date : 2001 .06 .14

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(56) Related Art
US 3993457

Abstract

Method for total material emission-free
utilisation of the synthesis clean gas obtained during
5 high-temperature recycling of waste of all types, in which
method the synthesis clean gas is continuously converted in
a catalytic process into carbon dioxide and hydrogen, at
least partially.

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AUSTRALIA
Patents Act 1990

COMPLETE SPECIFICATION
STANDARD PATENT

Applicant(s):

THERMOSELECT AG

Invention Title:

SYNTHESIS CLEAN GAS

The following statement is a full description of this
invention, including the best method of performing it known to
me/us:

Title: Synthesis Clean Gas

Specification

5 All the known thermal processes for disposing of waste are characterised in that emissions in gaseous form are produced and in that residual materials remain to be dumped.

10 In DE 41 30 416 C1, a thermal process for waste utilisation is described which, in comparison with all the known processes used in industrial production, has substantial ecological, economic and technical advantages. The resultant granulated mineral material is absolutely
15 inert; the iron metal alloy can be used metallurgically. In claim 11 of this method it is proposed that purified synthesis gas should be used thermally or as energy; in so doing, harmful substances, caused by the combustion process, are inevitably produced which can damage the
20 atmosphere at least partially. The heavy metals contained in the synthesis gas and compounds of chlorine and fluorine are separated, and, amongst other things, a heavy metal sulphide or hydroxide sludge is produced which has to be dumped.

25 Although with this method only minimal concentrations of harmful substances can occur which lie far below all regulations and standards, and the residual amounts to be dumped lie at below 1% measured against the
30 input, this method, too, is neither emission-free nor free of residue.

The object underlying the present invention is to develop a method in which the synthesis gas is completely
35 used as a substance and no emissions are produced.

According to the present invention there is



provided A method for total material emission-free utilisation of synthesis clean gas obtained during high-temperature recycling of waste of all types, including:

5 treating the synthesis clean gas by water vapour
in a catalytic process in order to convert carbon monoxide
contained in the synthesis gas at least partially into
carbon dioxide and hydrogen;

 recycling the remaining residual gases back into
the high-temperature reactor, and then;

10 separating the clean synthesis gas main product
obtained, containing hydrogen, carbon monoxide and carbon
dioxide into component hydrogen and/or carbon monoxide
and/or carbon dioxide and utilising the components.

15 Advantageous further developments and embodiments
of the achievement of this object arise from the secondary
claims.

20 According to the invention, it is thus proposed
that synthesis clean gas, preferably stemming from the
process such as is described in DE 41 30 416 C1, be
converted at least partially into CO₂ and hydrogen. It
should be particularly emphasised that the remaining
residual gases can be led back into the high-temperature
25 reactor, and the process takes place without emissions.
The converted components are then put to some use.

30 A preferred form of embodiment provides for the
synthesis clean gas, consisting essentially of hydrogen,
carbon monoxide and carbon dioxide, to be acted on by water
vapour in a catalytic process, in order to convert the
carbon monoxide contained in the synthesis gas completely
into hydrogen and carbon dioxide ($\text{CO} + \text{H}_2\text{O} \rightarrow \text{H}_2 + \text{CO}_2$).
The two gas components, hydrogen and carbon dioxide, can be
35 separated by generally known methods (such as a pressure
swing adsorption plant, for example) and used commercially.



Carbon dioxide can be condensed, cooled and used as dry ice.

5 Hydrogen can be used as energy and/or as a substance. If hydrogen is used as a general or motor fuel, this is an absolutely emission-free energy carrier, since only water is produced when hydrogen is used as energy ($2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$).

10 If hydrogen instead of fossil fuels, the damage to the environment which inevitably results from the use of



fossil fuels is dispensed with. Since the raw materials, from which fossil fuels are obtained, are limited, these resources can be used more sensibly.

5 Moreover, hydrogen can be used in fuel cells as energy to produce electric power. Compared with conventional power stations, fuel cells not only have a substantially higher degree of efficiency, they also generate electric power without any harmful substances
10 being produced in the process.

 Hydrogen can be used as a substance in hydrogenation and synthesis processes, for example. In organic hydrogenation, organic molecules existing under
15 pressure and at defined temperatures are enriched with hydrogen.

 In inorganic hydrogenation, metal oxides are reduced with hydrogen to metals
20 (e.g. $\text{WO}_3 + 3\text{H}_2 \rightarrow \text{W} + 3\text{H}_2\text{O}$).

 "Ammonia" can be produced in a synthesis from hydrogen and nitrogen. It should be particularly stressed that the oxygen needed for waste gasification is obtained
25 with an air separation plant; nitrogen also results from this which can be used commercially for the synthesis of ammonia. It is particularly advantageous that the air separation plant is already a component part of the process.

30 If hydrogen is to be used for the manufacture of methanol, it makes sense to convert the carbon dioxide present in the synthesis gas into hydrogen and carbon by applying water vapour to it, to the extent that hydrogen
35 and carbon monoxide are present in the synthesis gas in a ratio of 2:1 (partial conversion).

Next, carbon dioxide is separated by generally known methods, hydrogen and carbon monoxide are submitted to a synthesis, and methanol results.

5 Through the use of the hydrogen as a substance, chemical raw materials are obtained which are able to be stored and transported and which can be used in a variety of ways.

10 It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents forms part of the common general knowledge in the art, in Australia or in any other country.

15 For the purposes of this specification it will be clearly understood that the word "comprising" means "including but not limited to", and that the words "comprise" and "comprises" have a corresponding meaning.

20



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for total material emission-free utilisation of synthesis clean gas obtained during high-temperature recycling of waste of all types, including:
 - treating the synthesis clean gas by water vapour in a catalytic process in order to convert carbon monoxide contained in the synthesis gas at least partially into carbon dioxide and hydrogen;
 - recycling the remaining residual gases back into the high-temperature reactor, and then;
 - separating the clean synthesis gas main product obtained, containing hydrogen, carbon monoxide and carbon dioxide into component hydrogen and/or carbon monoxide and/or carbon dioxide and utilising the components.
2. A method according to claim 1 in which separating the main product into the component takes place in a known separation process.
3. A method according to claim 2 in which the known separation process takes place in a pressure swing absorption plant.
4. A method according to any preceding claim in which the synthesis clean gas thus obtained is subjected continuously to partial conversion until hydrogen and carbon monoxide reach the necessary volume ratio of 2 to 1 for the synthesis of methanol; thereafter carbon dioxide is separated by generally known methods such that, from the remaining hydrogen-carbon monoxide mixture, methanol can be obtained in a synthesis ($2H_2 + CO \rightarrow CH_3OH$).
5. A method according to any one of claims 1 to 3, in that the synthesis clean gas so obtained is completely converted into carbon dioxide and hydrogen, and the substances so obtained are used separately.



6. A method according to claim 5, in which the hydrogen is used, together with the nitrogen from the air separation in the generation of oxygen during high-
5 temperature gasification, for the synthesis of ammonia.

7. A method according to claim 5, in which the hydrogen is used by preference as a fuel to run the fleet of lorries charging the thermal treatment installation.
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8. A method according to claim 5, in which the hydrogen is used in fuel cells to generate electric power.

9. A method for total material emission-free
15 utilisation of synthesis clean gas obtained during high-temperature recycling of waste substantially as hereinbefore described with reference to the foregoing description.

20 Dated this 17th day of April 2001

THERMOSELECT AG

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