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(71) Applicant(s)
Buhler AG

(72) Inventor(s)
Claudemiro Ferreira; Urs Georg Naef; Camille Borer

(74) Agent/Attorney
GRIFFITH HACK,GPO Box 1285K,MELBOURNE VIC 3001

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(71) Anmelder *(für alle Bestimmungsstaaten ausser US)*: BÜHLER AG [CH/CH]; CH-9240 Uzwil (CH).

(72) Erfinder; und
(75) Erfinder/Anmelder *(nur für US)*: FERREIRA, Claudemiro [BR/CH]; Grünring 9, CH-9524 Zuzwil (CH). NAEF, Urs, Georg [CH/CH]; Alte Schaffhauserstrasse 8, CH-8413 Neftenbach (CH). BORER, Camille [CH/CH]; Hellerweg 12, CH-8247 Flurlingen (CH).

(74) Gemeinsamer Vertreter: BÜHLER AG; Patentabteilung, CH-9240 Uzwil (CH).

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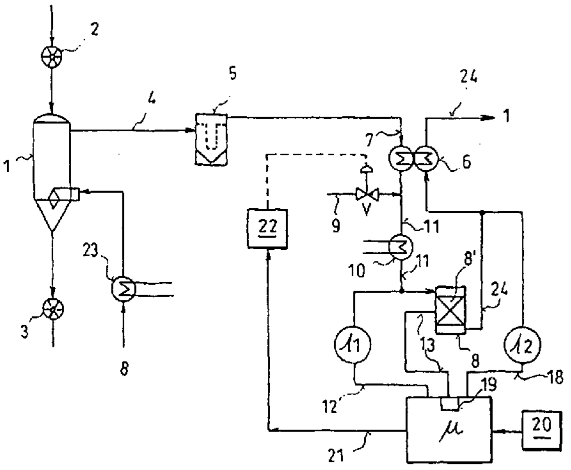
(54) Title: METHOD FOR PURIFYING A GAS STREAM

(54) Bezeichnung: VERFAHREN ZUR REINIGUNG EINES GASSTROMS

(57) Abstract

The invention relates to a method for purifying a gas stream containing impurities composed of organic compounds, said gas stream flowing out of a reactor (1) designed for solid phase condensation, preferably for aromatic polyesters and polyamides. According to said method, a gas containing at least oxygen is fed to the gas stream containing the impurities. The combined gas stream is then conveyed, at a high temperature, especially from 280 °C to 380 °C, onto a catalyst (8) containing rhodium or a rhodium alloy on an inert porous support. It was found advantageous that the amount of oxygen used be hypo stoichiometric, in relation to the organic impurities, and/or that the ratio of oxygen to impurities be controlled by means of a lambda probe (Λ). Such a lambda probe (Λ) is used in a facility according to the invention.



METHOD FOR CLEANING A GAS STREAM

The present invention relates to a method and an arrangement for cleaning a gas stream emitted from a reactor.

Methods and arrangements of this kind are disclosed in U.S. patent 5,547,652 or 5,612,011. They concern the cleaning of exhaust gas of the process by means of a catalyst (in contrast to cleaning by scrubbing), or, in other words, they concern afterburning (oxidation) of the contaminants. It is understood that accordingly the ratio of the oxygen quantity relative to the contaminants is of utmost importance. In this context, in the past two considerations were decisive: on the one hand, it was assumed that for complete oxidation of the contaminants at least a stoichiometric quantity of oxygen was required. On the other hand, it was thought that in view of this requirement the monitoring of the oxygen quantity was the best means of controlling the cleaning process.

During the course of time it was found that, despite a supply of a stoichiometric quantity of oxygen, the oxidation was not complete so that the first mentioned patent still allows up to 10 ppm of uncombusted oxygen. This also proved to be less than optimal with regard to the cleaning effect so that the excess of the oxygen quantity was still increased. As a consequence, in the second named patent an even higher quantity of uncombusted oxygen of 250 ppm had to be accepted; it was, however, thought that this had led to an optimal result.

The two aforementioned patents relate to the cleaning of process gases of the manufacture of aromatic polyesters. Of course, the gas cleaning is especially of interest for aromatic compounds, and, in particular, in this case of polyesters; however, it is apparent that such cleaning methods can also be applied for other gases and contaminants, for example, also for polyamides, such as aromatic PA or also for the cleaning of exhaust gases when processing natural substances as in coffee or cocoa roasting.

In "Das Techniker Handbuch" by Alfred Böge, Vieweg-Verlag, pp. 1158 and 1159, a special ZrO_2/Pt oxygen sensor is described as typically employed in the automobile technology.

EP 0 699 471 A1 describes a method for cleaning the substantially oxygen-free process gases of the thermal solid phase treatment of condensation polymers, wherein for catalytic oxidation of the oxidizable organic contaminants an at most stoichiometric, i.e., optionally sub-stoichiometric quantity of oxygen is added. Here the carbon monoxide contents, which is related to the oxygen contents, is determined at the exit of the oxidation reactor, for example, by means of a micro fuelcell via which indirectly the oxygen content can be determined. However, this has the disadvantage that relatively high carbon monoxide contents must be accepted.

The present invention now goes in the opposite direction. This basically means that instead of placing the amount of oxygen in the foreground, the amount of the residual impurities is taken as the measuring stick or rather, the ratio of oxygen to residual impurities. This first step of the invention subsequently resulted in surprising findings. On the one hand, tests by the applicant showed that—in direct contradiction to previous observations by the specialists—stoichiometric or hyper-stoichiometric oxygen amounts do not lead to optimal purification and that the previous measures not only necessitate a large amount of oxygen (if one does not simply use air), but, rather, the entire system became oversized and too expensive. On the other hand, it was proven that the previously used measuring principle was based on incorrect assumptions and thereby finally delivered inexact results.

For this reason, the basic object of the present invention is to improve the previous methods for purifying a gas flow.

According to the present invention there is provided a method for cleaning a gas stream emitted from a reactor used for the solid phase condensation of compounds such as aromatic compounds or aromatic polyesters, said gas stream containing organic contaminants, said method comprising:

- supplying at least one oxygen-containing gas to the contaminated gas stream; and
- guiding the combined gas stream at an elevated temperature across a catalyst;

wherein the employed oxygen quantity in said oxygen-containing gas is sub-stoichiometric relative to the organic contaminants, and the ratio of oxygen to organic contaminants is monitored in the combined gas stream by means of at least one lambda sensor.

The preferred temperature range at which the gas stream is guided across the catalyst is between 280-380°C.

The preferred amount of sub-stoichiometric oxygen is 98 % to < 100 %, preferably at least 99 %, of the stoichiometric amount.

It is completely surprising that even a sub-stoichiometric amount of oxygen leads to a better result, and the theoretical explanation for this phenomenon does not yet exist. Tests have, however, confirmed this fact; namely, hardly any further measurable residual impurities or residues of nonburned oxygen are being determined. Naturally, it is difficult to still monitor such small residues at all. It has been shown that if one actually wishes to carry the improvement with regard to purification to the extreme the customary oxygen sensor delivers only imperfect results. For this reason, according to the invention, one plans to use a lambda probe. It is obvious, in this regard, that such a lambda probe enables better monitoring also in the case of the previously known method, when one utilizes stoichiometric or hyper-stoichiometric oxygen amounts, and that they are, however, especially advantageous where the quantities to be monitored are especially small.

A lambda sensor (according to Römpps Chemical Lexikon "Λ" is used as a symbol for molar electrolyte conductivity) represents two noble metal layers, such as platinum, on a solid electrolyte with connected electrodes. It is apparent that this construction is very similar to that of the catalyst to be monitored. Accordingly, in the context of the invention, it is indeed possible to utilize the catalyst itself as the lambda sensor-like measuring cell, wherein the monitoring signal must, of course, be correspondingly filtered out, decoupled, or demodulated.

A side from how and where the lambda sensor may be interconnected, it is an important characteristic of its use that now a direct measurement of the participating elements or electrolytes instead of the previous indirect measurement is possible, wherein, in addition, the lambda sensor has an especially favourable characteristic for an exact measurement.

That it has not been used before is probably a result of the fact that one was influenced by the stoichiometric or hyper-stoichiometric oxygen quantity that it was assumed that the uncombusted oxygen had to be measured. With the lambda sensor there is more freedom also with respect to the process control because, when the method according to the invention is employed for other processes than the polycondensation of synthetic resins, an inert gas is possibly not at all required, wherein the measurement in the prior art measuring method would be additionally impaired due to the oxygen present in the process.

In any case, as is known in the art, an inert gas can be used as the contaminant gas which is preferably returned after cleaning at least partially into the reactor.

In order to convert the simple monitoring, which can be actually performed by the operating personnel, into a control that reacts as quickly as possible or at least to make a control possible, it is however preferred when monitoring is carried out by means of at least one lambda sensor upstream of the catalyst and/or that monitoring by means of at least one lambda sensor is carried out at the catalyst. Even though, of course, the monitoring of the end result of the cleaning, i.e., after the catalyzer, is of particular interest; however, such monitoring can also be additionally included in the regulatory measure.

An especially preferred system for performing the method is when the catalyst is used as a lambda sensor-like measuring cell.

According to the present invention, there is also provided a preferred arrangement for performing the above-described method, the arrangement comprising:

- a solid phase condensation reactor, which in use, emits a contaminated gas stream;
- a catalyst unit;
- a first inlet line for receiving and conducting said contaminated gas stream from the solid phase condensation reactor towards the catalyst unit;
- an air feed device in fluid communication with said first inlet line for supplying a gas comprising at least oxygen to said contaminated gas stream to form a combined gas stream;
- a collecting line for receiving and conducting said combined gas stream to the catalyst unit for treatment in the catalyst unit;
- at least one outlet line connected to the catalyst unit;

wherein each of said collecting line and said outlet line has a lambda sensor.

The lambda sensors are preferably connected to the collecting line, characterised in that one or more lambda sensors are connected to the collecting line downstream of the inlet of the air feed device into the first inlet line. The catalyst body can comprise rhodium, preferably a rhodium alloy. The arrangement further comprises a processor and a differential element, where the differential element is preferably arranged between the lambda sensor arranged downstream of the catalyst and the processor.

Further details of the invention are elucidated in the following description of an embodiment schematically shown in the drawing as well as in the embodiments given of the method. Shown are:

Fig. 1 A schematic of the method underlying the invention with an embodiment according to the invention;

Fig. 2 The design of a lambda probe used according to the invention;

Fig. 3 Its characteristic; and

Fig. 4 A further characteristic of the lambda probe.

A reactor 1 is provided for the solid phase condensation of polyester resins, such as, polyethylene-terephthalate. It is conventionally designed so that a detailed description is unnecessary, wherein the supply and removal of resin material occurs via cellular wheel sluices 2 or 3. The exhaust gas from the condensation process is guided through an exhaust gas line 4 first through a filter 5 for removal of particle-shaped impurities. Afterwards the waste heat of this gas containing gaseous impurities is suitably exploited in a heat exchanger 6, which is provided in a supply line 7 to a catalyzer 8.

An air feeder 9 provides for the feeding of a gas containing at least oxygen, i.e., either pure oxygen or a gas such as air that contains only a corresponding portion of oxygen. This oxygen is needed for the oxidation of the impurities contained in the gas flowing through the supply line 7 and flows into the supply line 7 just in front of the catalyst 8 with the aid of an electrical heater 10 is brought to an optimum temperature for the oxidation taking place in the catalyst 8. It is expediently within the range of 280°C to 380°C. Subsequently, the collecting line 11 enters the catalyst 8. The catalyst unit 8, 8′ also comprises an outlet line 24 which is returned advantageously to the reactor, for example, via a heater 23 or upstream via the heat exchanger 6, especially when – as is conventional in polycondensation – the gas to be cleaned is an inert gas such as nitrogen.

A lambda sensor Λ_1 is positioned at the collecting line 11 shortly upstream of its entry into the catalyst 8 and it separates the combined gases into their electrolytes or elements and analyzes them quantitatively. According to this analysis, a corresponding, preferably digital, output signal is released via an electrical line 12. In the illustrated embodiment a further electrical line 13 is additionally provided which communicates directly with the catalyst 8.

The catalyst body 8′ is constructed similar to the lambda sensor Λ, shown in Fig. 2 in section, i.e., a porous inert carrier layer 16 is provided having applied to its surface a noble metal layer 14. The lambda sensor has also a solid electrolyte 17 which is coated with a noble metal layer 15. The layer 17 can be comprised, for example, of zirconium oxide ZrO_2, while the layers 14 and 15 are usually comprised of platinum, i.e. are either comprised completely of platinum or of an alloy. While actually palladium alloys are conventional, according to the invention a rhodium alloy is preferably provided for the catalyst body 8′. On the other hand, the lambda sensor itself can comprise pure platinum layers 14, 15. Between the layers 14 and 15 a direct voltage U is applied which causes the desired electrolyte activity. In this connection, the gas to be examined is at the side of the layer 16 while air (as reference) is present on the side of the noble metal layer 15.

As a result of the similar construction of the sensor Λ and of the catalyst 8, it is conceivable to use the catalyst 8 itself as a lambda sensor-like measuring device, i.e., for determining the electrolytes, and the output signal resulting therefrom is supplied to the lines 13 (Fig. 1).

Alternatively or cumulatively, a further lambda sensor Λ_2 can be additionally provided, in particular at the exit of catalyst unit 8, 8'. It can measure the result of the cleaning action and accordingly can provide a corresponding signal to the line 18. It is understood that optionally only a single lambda sensor can be used also, but, conversely, it is also within the gist of the invention to provide further measuring locations with lambda sensors. Even though the lambda sensor Λ_2 measures the obtained result, it cannot be overlook that it measures only at a relatively late point in time along the course of the gas stream, which may be inexpedient for a fast control. In this respect, it may be favourable to provide in the line 18 a differential member in order to be able to determine more quickly the tendency of a possible occurring control deviation. On the other hand, for a quick control it would generally be more advantageous when at least the lambda sensor Λ_1 is utilized. In this case of using both lambda sensors Λ_1 and Λ_2, the additional advantage results that the ageing of the catalyst, which affects the measuring result, can be determined as has already been found in connection with automobile catalysts (Hansjörg Germann et al., "Differences In Pre- and Post-Converter Lambda-Sensor Characteristics", Electronic Engine Controls 1996, SP-1149, pp. 143-147).

In the illustrated embodiment with three measuring locations, the electrical lines 12, 13 and 18 extend to a processor μ which receives the signals of the lines 12 and 18 (inasmuch as they are already present in digital format) directly or has at its input an analog-digital converter, respectively. In this case of the line 13 generally a pre-processing of the measurement signal guided via it will be required in order to thus separate it from the noise signals etc. This can be carried out in a filter, a demodulator, or (generally) signal forming stage 19 at the input of the processor μ.

In the processor μ the temporal sequence of the measurements is taken into consideration first. The sequence becomes shorter (and thus less relevant for the control) as the flow velocity of the gases increases. If necessary, the input signals coming in via the lines 12, 13, and 18 are also weighted before they are compared with a NORMAL signal from a nominal signal transducer 20, which is preferably adjustable. Based on the result of this comparison, a deviation or control signal is produced which is guided from the output of the processor μ via a line 21 to a controller 22. The controller 22 changes advantageously in a corresponding way the valve V in the line 9.

Above, the construction of the lambda sensor Λ has already been described with the aid of Fig. 2. The advantage of using such a sensor resides not only in that it has a very steep characteristic as can been seen in Fig. 3. It shows on the ordinate the equilibrium partial pressure of oxygen in bar and on the abscissa the ratio of oxygen to contaminant gas to be combusted.

As an alternative, the output voltage of the respective lambda sensor can be plotted (compare the values for Λ_2 in Table 2) in which case the curve C is reversed and drops from the top left to the bottom right.

The lambda sensor Λ now has a characteristic C which, in particular, in the area of a dash-dotted line S, shows an especially steep ascent. The line S corresponds to a stoichiometric ratio of oxygen to contaminant gas to be combusted. Starting at this line S toward the left are the values of a "rich mixture", i.e., this is the sub-stoichiometric area with minimal oxygen quantities in which according to the invention the process is carried out. When a stoichiometric oxygen quantity is taken to be 100 %, a drop occurs to the left into the range of 99 %, while to the right the hyper-stoichiometric areas corresponding to an oxygen quantity of greater 100 % are present. In the control according to the invention the control action is carried out expediently in a range of the curve C which is between the points P1 and P2 whose spacing corresponds to the control range R.

A further characteristic of the lambda sensor can be seen in Fig. 4.

In a well-known, oxygen sensor, not illustrated, the components of the exhaust gas diffused through a diffusion channel to the electrodes of a pump and Nernst cell. A control electronic device measures the Nernst voltage and supplies the pump cell with a variable pump voltage. This control circuit is designed such that the exhaust gas composition in the area of the electrodes can be maintained at a constant value of $\Lambda = 1$. The controller compares the measured Nernst voltage with a set value and provides the pump cell with such a current that the oxygen concentration more and more approximates the set value.

Fig. 4 is used to depict how the pump current is dependent upon Λ and is thereby a measure for the oxygen concentration in the exhaust gas. Therein the pump current in I_p is registered on the ordinate, the air ratio of the exhaust gas in Λ on the abscissa.

In the lean area, an increasing oxygen concentration leads to a linear increase of the pump current. A similar linear characteristic, though with a reverse current direction is obtained in the rich area. The results of this are that, within the desired range of $0.98 < \Lambda < 1.00$, the pump current is a monotonic increasing function dependent upon lambda.

The self-regulating pump current I_p is a measure for lambda and thereby also a measure for the actual oxygen concentration in the exhaust gas. In the case of the regulation according to the invention, it is correspondingly effectively regulated in an area of curve C_1, which lies between points P1 and P2 in Fig. 4, whose spacing corresponds to a regulatory range R.

In the following, examples are provided to illustrate the method according to the invention and its results.

Example 1:

A certain uncertainty factor in a catalytic conversion is the effective conversion value of the catalyzer itself. Generally all 100 % of the impurities namely are not oxidized. Assuming that the gas mixture conveyed through supply line 7 contained 500 ppm (volume) of ethylene glycol and nitrogen, then purely stoichiometrically 1250 ppm oxygen would have to be added. The lambda value would then amount to exactly 100 % (factor 1.0). If, however, the conversion value of catalyzer 8 was only 99 %, then the remaining concentration of the oxygen not involved in the burning process after the catalyzer would still be 12.5 ppm, and correspondingly, that of unburned impurities, namely ethylene glycol, 5 ppm. For this reason, an initial test series was performed (see Table 1), in order to determine the residual concentrations of oxygen in the named gas mixture.

Table 1

Test No.	Factor of the Stoichiometric Oxygen Amount	Residual Oxygen for Catalytic Conversion of		
		100 %	99 %	95 %
1.1	1.01	12.5	25.0	75.0
1.2	1.00	0.0	12.5	62.5
1.3	0.99	0.0	0.0	50.0

In this table, the so-called lambda factor, i.e., the factor of the stoichiometric oxygen amount, was utilized. A test system of the type shown in Fig 1 was employed, wherein only the lambda probe Λ_2 was used, in order to determine the residual oxygen content in ppm. The lambda probe was a Bosch product, type LSM 11. For this, a state-of-the-art Pt catalyzer was used, for which a conversion of 95 % was known. The values for 100 % and 99 % were calculated on the basis of the found oxygen amounts.

Initially, in test 1, an oxygen excess of 101 % of the stoichiometric amount was used, corresponding to U.S. Patent No. 5, 547, 652. As expected, this resulted in a relatively high residual oxygen content of 75.0 ppm. Afterwards, in test 2, the stoichiometric oxygen amount of 100 % was examined. During this test No. 2, a residual oxygen amount of 62.5 ppm was still measured. Only in the case which does not occur in practice of a 100 % catalytic conversion of the gas ethylene glycol to be oxidized, a residual oxygen amount of 0 ppm would result.

Now, however, a test series with tests in the hypo-stoichiometric range was continued. The table shows only the values for the lambda factor 0.99, in which there still results a residual oxygen content of 50.0 ppm. In further tests not described herein, up to a factor of 0.90, however, also all residual oxygen disappeared or was no longer measurable. In this case it was interesting to determine that only at 95 % did a residue oxygen content of 0 ppm (95 % catalytic conversion) remain. Still further tests on even smaller portions of oxygen were performed, wherein allowing for tolerances evidently 90 % of the stoichiometric oxygen formed the lower limit, for which measurement results could be kept above zero. The table certainly shows that in the case of a higher catalytic conversion, e.g., one of 99 %, even when the oxygen content was only 99 % of the stoichiometric amount, a residual oxygen content of zero could be maintained; still, such a conversion is not possible under all conditions.

<u>Example 2:</u>

The next question to arise was how the amounts of ethylene glycol and other impurities would appear at the exit of catalyzer 8. One would expect that with decreasing residue oxygen content, the amount of nonburned ethylene glycol would increase. Therefore, a test design was chosen in which both lambda probes Λ_1 and Λ_2 were installed. The following Table 2 shows the sequence of the test series, wherein not only the oxygen (O_2) in ppm, but also the content of ethylene glycol (EG) in µg/l, and of acetaldehyde (AA) in µg/l, were measured with the lambda probe Λ_1 as well as Λ_2, and the content of hydrocarbon only on Λ_2. The values for residual amounts of these impurities are the values given in ppm v, i.e., volume parts per million. The value given in the last column on the right is in each case the electric output signal of the probe Λ_2 in millivolt, which is a measure for the lambda factor.

Table 2

Test No.	Λ_1 Factor	Values at Λ_1			Residual Values at Λ_2				mV
		[EG] ppm v	[AA] ppm v	[O_2] ppm v	[EG] ppm v	[AA] ppm v	[O_2] ppm v	[HC] [2] ppm v	at Λ_2
2.1	1.02	-	-	1420	-	-	>1000	1.5	93
2.2	1.01	30.4	7.1	165	<1.6	<1.3	20	1.2	180
2.3	1.01	30.8	6.9	155	<1.6	<1.3	10	0.9	189
2.4	1.01	31.9	6.9	140	<1.6	<1.3	1.1	1.5	835
2.5	1.00	27.4	6.6	105	<1.6	<1.3	1.1	1.2	858
2.6	0.98	26.9	6.3	95	<1.6	<1.3	1.0	1.6	875
2.7	0.97	29.0	6.6	88	<1.6	<1.3	1.0	2.1	880
2.8	0.95	23.9	6.3	76	<1.6	<1.3	1.0	2.3	886

[1] The values of EG and AA were below the measurable minimum value.

[2] For HC the ppm v of organic carbon was determined.

The above Table 2 shows that for a hypo-stoichiometric operation the residual values for EG and AA are essentially identically minimal as in the stoichiometric operation (experiment 2.5) or in an operation with excess of oxygen (experiment 2.1 to 2.4) so that therefore the current theory of persons skilled in the art has been proven to be false. The residual values for hydrocarbons were somewhat, but only minimally, above the residual values during operation according to the prior art. In summarizing the above, it can be said that the advantages of the method according to the invention outweigh significantly the minimally excess output of HC. In particular, it is also shown that by means of the lambda sensors Λ_1 and Λ_2 a much more precise measuring of the values of interest can be obtained which also makes possible a much more precise control and makes it useable in this way. Accordingly, the gas cleaning can also be performed much more efficiently than was possible according to the prior art.

Example 3:

Moreover, an experimental configuration was selected in which the two lambda sensors Λ_1 and Λ_2 of Fig. 1 were installed. The following Table 3 shows the results of the experimental series upstream and downstream of the catalyst 8, wherein the contents of hydrocarbons is equivalent (FID) to that of propane gas (C_3H_8).

Since in FID analyses carbon monoxide (CO) is also measured, carbon monoxide (CO) and carbon dioxide (CO_2) were measured in addition separately upstream and downstream of the catalyst.

The measurements of the exhaust gases by the gas chromatograph (GC) confirmed that no ethylene glycol (EG) and no acetaldehyde (AA) are present.

Table 3

Inlet						Outlet						
Trial #	Λ_1 -	Λ_1 µA	$[FID]_1$ ppm v	$[CO]_1$ ppm v	$[CO_2]_1$ % v	Λ_2 -	Λ_2 µA	$[FID]_0$ ppm v	$[CO]_0$ ppm v	$[CO_2]_0$ % v	$[GC]_0$ ppm v	$[O_2]_0$ ppm v
1	0.999	-1	62	72	6.5	0.999	-3	8.8	1.9	8	0	0....1
2	0.999	-1	63	50	7	0.999	-2	6.8	30	8.5	0	0...1
3	0.999	-1	63	65	4.5	0.999	-3	4.8	13	6	0	0...1
4	1.000	1	57	18	2	0.999	0	0.3	0	6	0	0...1
5	1.001	2	62	-	-	1.000	0	0.2	-	-	0	12...15

The above Table shows that in the sub-stoichiometric range (experiments 1-3) the residual contaminants on FID are only slightly above those for a stoichiometric operation (experiment 4). Moreover, it can be seen that in the hyper-stoichiometric operation (experiment 5) the values of CO are below the measurable minimal value.

Even though oxygen is added within the sub-stoichiometric range to the exhaust gas (experiments 1, 2, 3), the undesirable contaminants are completely combusted or remain in such minimal quantities that they are no longer measurable.

In this specification, except where the context requires otherwise, the words "comprise", "comprises", and "comprising" mean "include", "includes", and "including", respectively, ie when the invention is described or defined as comprising specified features, various embodiments of the same invention may also include additional features.

AUSTRALIAN PATENT OFFICE

Terminology and Symbols

Λ, Λ_1, Λ_2, etc.	Lambda probe
μ	Processor
V	Valve in Conduit 9
1	Reactor
2, 3	Cellular Wheel Sluices
4	Exhaust Gas Line
5	Filter
6	Heat Exchanger
7	Supply Lines to the Catalyzer
8, 8′	Catalyzer Unit (8 Catalyzer, 8′ Catalyzer Body)
9	Air Feeding
10	Electric Heater
11	Collecting Main
12, 13, 18, 21	Electrical Conductors
14, 15	Metal Films
16	Carrier Layer
17	Solid Electrolytes
19	Signal-Shaper Step on the Input of the Processor
20	Set Value Transmitter
22	Regulator
23	Heater
24	Output line

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for cleaning a gas stream emitted from a reactor used for the solid phase condensation of compounds, said gas stream containing organic contaminants, said method comprising:

- supplying at least one oxygen-containing gas to the contaminated gas stream; and
- guiding the combined gas stream at an elevated temperature across a catalyst;

wherein the employed oxygen quantity in said oxygen-containing gas is sub-stoichiometric relative to the organic contaminants, and the ratio of oxygen to organic contaminants is monitored in the combined gas stream by means of at least one lambda sensor.

2. The method according to claim 1 wherein the gas stream containing organic contaminants is emitted from a reactor used for the solid phase condensation of aromatic compounds.

3. The method according to claim 2 wherein the gas stream containing organic contaminants is emitted from a reactor used for the solid phase condensation of aromatic polyesters.

4. The method according to any one of claims 1 to 3 wherein the combined gas stream is guided across a catalyst at a temperature of between 280 - 380°C.

5. The method according to any one of claims 1 to 4, wherein the contaminated gas is an inert gas which is returned at least partially to the reactor after cleaning.

6. The method according to any one of claims 1 to 5, characterised in that the sub-stoichiometric oxygen quantity is at least 98% but less than 100% of the

stoichiometric quantity.

7. The method according to claim 6, characterised in that the sub-stoichiometric oxygen quantity is at least 99% but less than 100% of the stoichiometric quantity.

8. The method according to any one of claims 1 to 7, characterised in that the monitoring by means of at least one lambda sensor is carried out upstream of the catalyst and/or the monitoring is carried out by means of at least one lambda sensor at the catalyst.

9. The method according to claim 8, characterised in that the monitoring is carried out by at least one lambda sensor upstream and downstream of the catalyst.

10. The method according to claim 9, characterised in that the monitoring signals released by the lambda sensors upstream and downstream of the catalyst are weighted before further processing.

11. The method according to claim 9 or claim 10, characterised in that at least the monitoring signal or signals of the lambda sensor(s) downstream of the catalyst is/are differentiated before further processing.

12. The method according to any one of claims 1 to 11, characterised in that the catalyst itself is used as a lambda sensor-like measuring cell.

13. The method according to claim 12, characterised in that the monitoring signal provided by the lambda sensor-like measuring cell is filtered and decoupled or demodulated.

14. The method according to any one of claims 1 to 13, characterised in that the monitoring provides an

ACTUAL value which is compared with a NOMINAL value and the derivation resulting therefrom is used for controlling the supply of oxygen.

15. An arrangement for performing the method according to any one of claims 9 to 14, comprising:
- a solid phase condensation reactor, which in use, emits a contaminated gas stream;
- a catalyst unit;
- a first inlet line for receiving and conducting said contaminated gas stream from the solid phase condensation reactor towards the catalyst unit;
- an air feed device in fluid communication with said first inlet line for supplying a gas comprising at least oxygen to said contaminated gas stream to form a combined gas stream;
- a collecting line for receiving and conducting said combined gas stream to the catalyst unit for treatment in the catalyst unit;
- at least one outlet line connected to the catalyst unit;

wherein each of said collecting line and said outlet line has a lambda sensor.

16. The arrangement according to claim 15, characterised in that one or more lambda sensors are connected to the collecting line downstream of the inlet of the air feed device into the first inlet line.

17. The arrangement according to claim 15 or claim 16, characterised in that the catalyst body comprises rhodium.

18. The arrangement according to claim 17, characterised in that the catalyst body comprises a rhodium alloy.

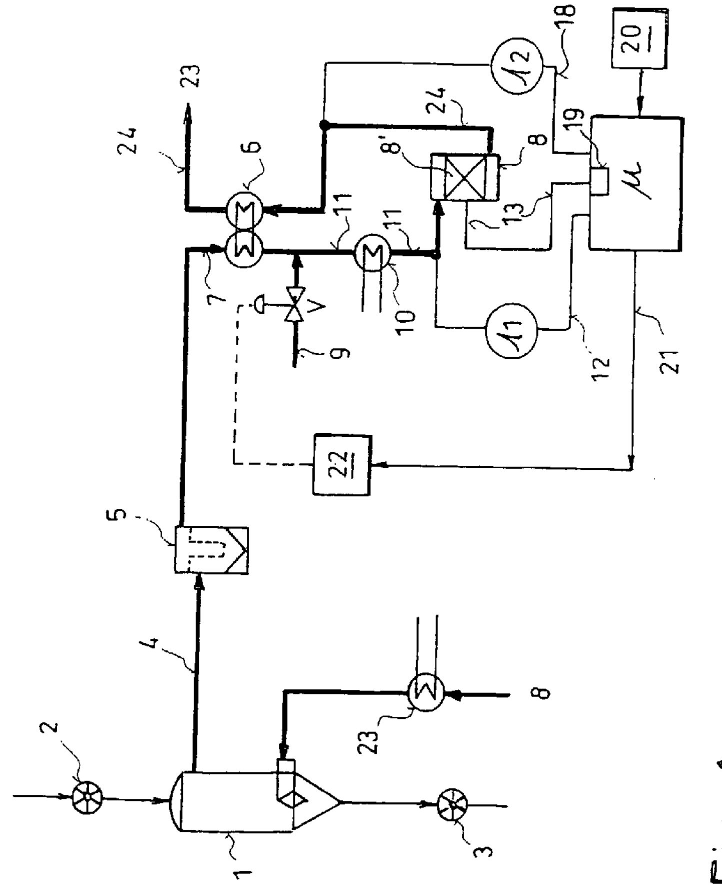
19. An arrangement according to claim 15 or claim 16,

characterised in that the arrangement includes a processor and a differential element, said differential element is arranged between the lambda sensor arranged downstream of the catalyst and the processor.

20. A method for cleaning a gas stream substantially as herein described with reference to the following examples.

21. An arrangement for cleaning a gas stream substantially as herein described with reference to the following examples and/or figures.

Dated this 19th day of July 2002
BUHLER AG
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
Trade Mark Attorneys of Australia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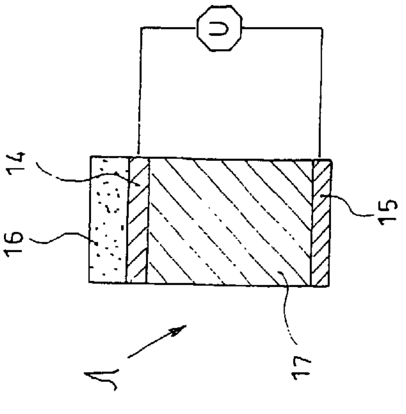
22
23
23
24
24
λ1
λ2
μ
V

Fig. 1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14
16
15
17
λ

Fig. 2

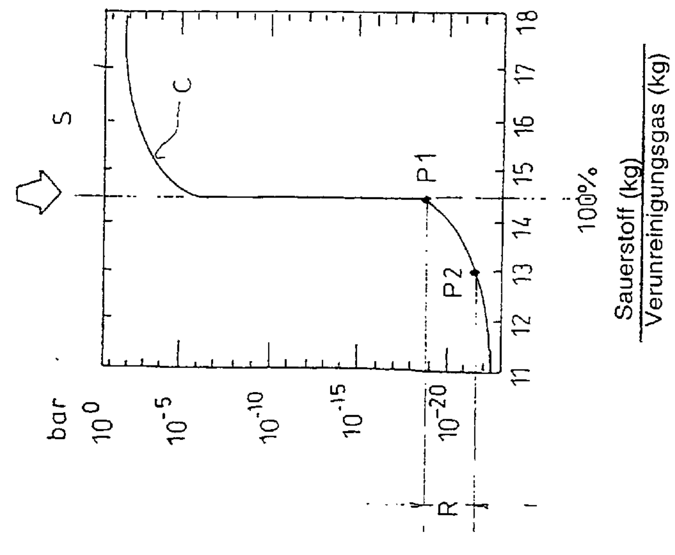
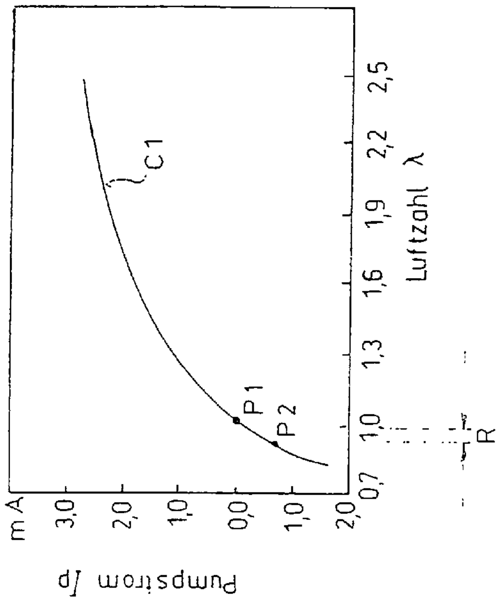

bar
10^0
10^{-5}
10^{-10}
10^{-15}
10^{-20}
R
S
C
P1
P2
11
12
13
14
15
16
17
18
100%
Sauerstoff (kg) / Verunreinigungsgas (kg)

Fig. 3


Pumpstrom Ip
mA
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1,0
0,0
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2,0
0,7
1,0
1,3
1,6
1,9
2,2
2,5
Luftzahl λ
C1
P1
P2
R

Fig. 4