PURIFICATION OF GASES, NEUTRALIZING DURABLE CONTAMINATIONS IN GASES, NEUTRALIZING DIOXINS, FURANTS, ETC.

ELIMINATING PERMANENT CONTAMINATIONS FROM GASES BY MEANS OF A ROTATING GAS PLASMA

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What was described was the method of destructing and neutralizing durable and dangerous substances in gases. This method is applicable inter alia in technologies of neutralizing PCB, asbestos fibres and other substances hazardous for people.

Known methods of purifying gases from toxic contaminants usually allow decreasing the organic contamination significantly, as well as isolating some of the substances by means of such technologies, as:
- absorbent methods,
- ozonization,
- thermal and thermo-catalytic combustion,
- adsorbent methods, and
- masking odors.

These methods are nevertheless not efficient in case of gases containing dangerous and very durable substances, not undergoing complete decomposition during thermal processing, even in relatively high temperatures. In case of some air contaminations other methods and technologies occur to be equally ineffective. An example could be the substances from the PCB group (dioxins, furans, etc.), which can be fully eliminated only in temperatures exceeding 1000ºC. An equally durable air pollution are small asbestos fibres getting into the air in consequence of mechanical damage of materials containing asbestos, e.g. during deconstruction works on building materials containing asbestos (asbestic tiles).

The following article contains a description of a new method of purifying gases containing contaminants, which cannot be eliminated by means of conventional methods and which are a huge threat for people and the natural environment.

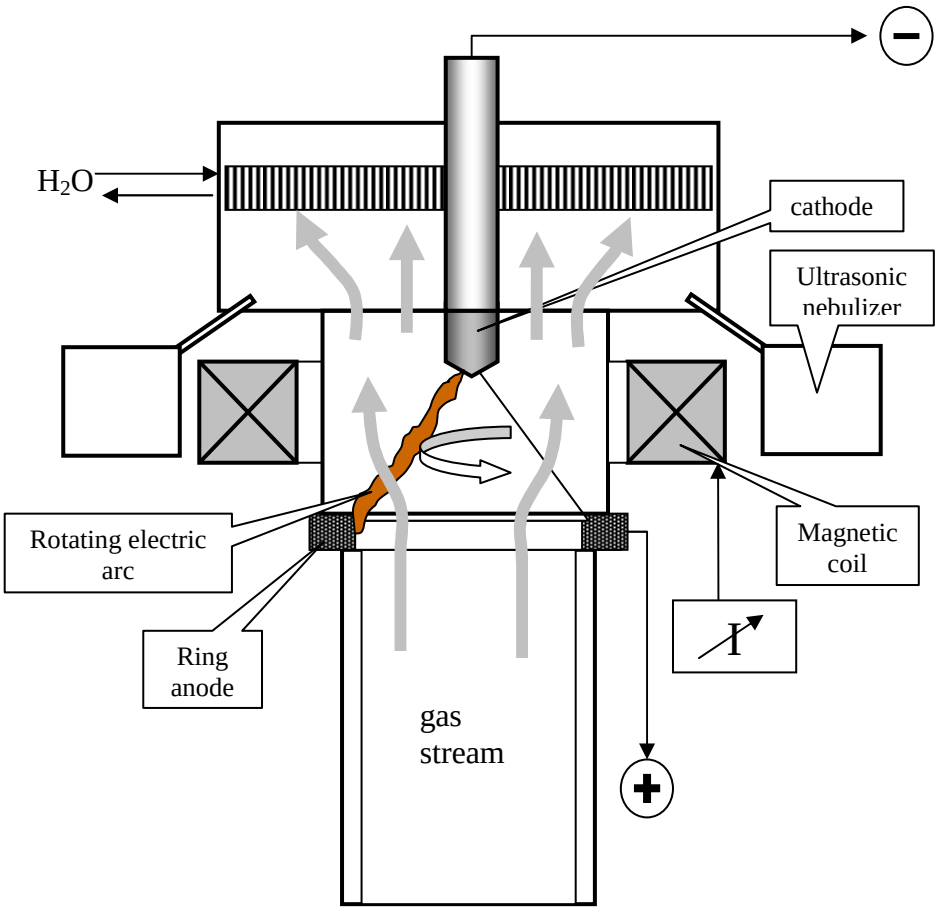
The nature of the original method of purifying gases is based on a quick thermal dissociation of all chemical compounds present in the stream of output gases, together with partial ionization of these gases during a forced “pass – through” the sphere of aroused gas plasma. Then the partially ionized gas, after so called recombination zone, is cooled very quickly. The point is to cool the mixture of aroused and partially ionized particles leaving the zone of gas plasma quickly enough and in such an atmosphere that a synthesis of

dangerous chemical compounds, including dioxins and furans, is prevented from taking place.

Description of the offered method

The most important elements of the suggested solution include:
- forced pushing of output gases through the zone of plasma discharge;
- then the process of rapid cooling of those gases in a controlled atmosphere of additional gases.

In order to push the whole amount of output gases through the plasma zone, a plasma discharge was proposed, which would include rotating the plasma stream in a strong external magnetic field. It can be done by forming an anode into a ring and initiating a discharge among an axially located cathode and a ring anode, as it is presented in the Picture 1.



Picture 1. A scheme of installation with rotating stream of arc plasma.

The rotating plasma forms a high-temperature cone of partially ionized gas between the cathode and ring anode, which is where a stream of contaminated gas passes through. In the zone of plasma discharge (in the plasma „cone") the contaminated gas is rapidly heated, the dissociation of molecules, partial ionization of gas particles and their arousal occur. All simple and complex chemical compounds, including dangerous ones, are then quickly decomposed (dissociated). Right above the plasma cone there is

the zone of quick cooling. Water mist from one or many ultrasonic nebulizers or water sprayers is directed there. Drops of water injected to the zone with hot gases evaporate rapidly and may be partially dissociated. The amount of energy required to evaporate the water is relatively high (above 2500 kJ/kg H_2O). In consequence, a rapid cooling of the gases leaving the zone of the plasma discharge (the plasma cone) occurs. Additionally, the speed of gas cooling is also influenced by a specially constructed grate cooler, located just above the zone of plasma discharge. The cooler may consist from a system of thin – wall pipes with cool water running inside of them.

Oxygen, or a mixture of oxygen and ozone, may be introduced together with the drops of water. It will allow to make the oxidizing (combustion) process of some elements (present in the zone above the plasma cone) more efficient. The adjustment of the processing gas composition may have a significant influence on the chemical composition of gases leasing the device and is intended to be one of the most import ant research objectives of the ATON-HT Ltd. company, both during laboratory tests and during tests at industrial scale.

Advantages of the method

- It is possible in the designed reactors with rotating gas plasma to neutralize very dangerous and difficult to eliminate contaminants in gases.
- Due to a very high temperature in the reaction zone, such substances undergo decomposition (dissociation), which cannot be decomposed or bound using conventional chemical methods.
- The process may be adjusted and optimized for various kinds of contaminants, by means of choosing appropriate composition of processing gases and the methods of cooling the dissociation products.
- Due to a very high temperature All dangerous organic substances, including bacteria, viruses and the most durable, biologically active substances, are destroyed in the re action zone.
- Reactors with rotating gas plasma may constitute a movable segment added to the existing technological installations, e.g. in the dangerous substances incinerators, in chemical reactors, etc.