International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 13, Issue 10 [October. 2024] PP: 100-102

Production of oxygen, hydrogen and carbon dioxide using volatile liquids like acetone (CH_3-CO-CH_3), Methyl alcohol (CH_3OH), Ethyl alcohol (C_2H_5OH), Propyl alcohol (C_3H_7OH), butyl alcohol (C_4H_9OH) under the influence of ultrasonic waves and the procedure to separate out these gases

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Abstract: *Oxygen, hydrogen and carbon dioxide production using volatile liquids like acetone, Methyl alcohol, Ethyl alcohol, Propyl alcohol, butyl alcohol under the influence of ultrasonic waves are presented. The probable procedure of separation of oxygen, hydrogen and carbon dioxide using Polytetrafluoroethylene (PTFE) membrane is also presented. To make gas permeable through first PTFE membrane with molecular size of H_2 (0.120 nm) pressure should be applied in to chamber which contains the above three gases. Application of temperature will increase the volume of gas. This creates additional pressure in the chamber which leads to permeability of H_2 gas. By using second PTFE membrane with molecular size of O_2 (0.299 nm) the oxygen gas can be separated out. After complete permeable of O_2 gas the gas remained will be carbon dioxide gas.*
Keywords: *Oxygen; Hydrogen; Carbon dioxide; Acetone; Methyl alcohol; Ethyl alcohol.*

Date of Submission: 11-10-2024 Date of acceptance: 25-10-2024

I. Introduction:

There is scarcity of gases like oxygen, hydrogen and carbon dioxide which are useful in various industries for various applications. The oxygen is used in hospitals to diagnose the patients who need oxygen to breath in who in turn are facing breathing problem. Hydrogen is used in industries to produce the electricity and millions of tons of hydrogen are used in paper industry to make papers. Carbon dioxide is used in beverages to keep the beverages cool and preserve the soft drink.

In the commercial technologies for oxygen production, Cryogenic distillation separates oxygen from air by liquefying air at very low temperatures (-300°F) [1]. Ambient air is compressed in multiple stages with inter-stage cooling then further cooled with chilled water. Residual water vapor, carbon dioxide, and atmospheric contaminants are removed in molecular sieve adsorbers. The other commercial technology to separate the oxygen from air can be done with ion transport membrane [2].

Hollow fiber membrane gas separation technology is gaining widespread acceptance throughout the world for nitrogen recovery from air, hydrogen recovery from hydrogen-bearing gas mixtures, carbon dioxide and water recovery from natural gas [3].

Keeping this in mind we have suggested many chemical reaction to produce oxygen, hydrogen and carbon dioxide using volatile liquids like acetone (CH_3-CO-CH_3), Methyl alcohol (CH_3OH), Ethyl alcohol (C_2H_5OH), Propyl alcohol (C_3H_7OH), butyl alcohol (C_4H_9OH) under the influence of ultrasonic waves. The reactions presented in this paper needs trial and error experimentation to confirm the production of oxygen, hydrogen and carbon dioxide using ultrasonic waves. In the present paper calculation to know how much amount of oxygen, hydrogen and carbon dioxide is produced is presented. The possible way to separate the oxygen, hydrogen and carbon dioxide produced is also presented in this paper.

II. Results and discussion

The acetone (CH_3-CO-CH_3) is prepared by reaction of benzene (C_6H_6) alkalized with propylene (CH_3-CH-CH_3) and Oxygen (O2) at room temperature. The equation is as shown below.

$C_6H_6 + (CH_3\text{-}CH\text{-}CH_3) + O_2 \rightarrow (CH_3\text{-}CO\text{-}CH_3) + C_6H_5OH$ (Benzyl alcohol also called Phenol)

Benzene (C_6H_6) is immiscible with water (H_2O) at room temperature. Benzene may react with water at higher temperature in the presence of propylene (CH_3-CH-CH_3) to produce the acetone (CH_3-CO-CH_3) and Benzyl Alcohol (C_6H_5OH).

Generally materials (solids, liquids and gases) do not react at room temperature. To make reaction possible one need to apply temperature and pressure using proper catalyst.
The probable reaction using benzene, water and propylene may be as follows which needs to be investigated
$C_6H_6 + (CH_3\text{-}CH\text{-}CH_3) + 2H_2O \rightarrow (CH_3\text{-}CO\text{-}CH_3) + C_6H_5OH + 2H_2$ (under heat treatment)
In the earlier studies we have observed that during ultrasonic cleaning of perovskite compound (ABO_3) using acetone the acetone gets vaporized very quickly. From this one can infer that the perovskite acts as catalyst to dissociate the acetone in to O_2, H_2 and CO_2 during the ultrasonic cleaning. The probable reaction is as follows
$4(CH_3\text{-}CO\text{-}CH_3) \rightarrow O_2\uparrow + 12H_2\uparrow + CO_2\uparrow + 11C\downarrow$ (catalyzed by ABO_3 material under ultrasonic cleaning) (1)
$(CH_3\text{-}CO\text{-}CH_3) + 7H_2O$ (moisture or water vapor)$\rightarrow O_2\uparrow + 10H_2\uparrow + 3CO_2\uparrow$ (catalyzed by ABO_3 material under ultrasonic cleaning). (2)
The calculations of amount of O2, H2 and CO2 from CH_3COCH_3 by using equation in reverse order (equation 3) is shown below. It is difficult to obtain the above amounts using direct equations (equation 2)
$O_2\uparrow + 10H_2\uparrow + 3CO_2\uparrow \rightarrow (CH_3\text{-}CO\text{-}CH_3)$ (1 Kg) $+ 7H_2O$ (3)
M. W of O2*1000/M.W of $(CH_3\text{-}CO\text{-}CH_3)$)
31.999*1000/58.05=551.2316g (Amount of O2)
2.01568*1000*10/58.05=347.2316 (Amount of H2)
44.01*3*1000/58.05=2274.4186 (Amount of CO2)
18.01528*1000*7/58.05=2172.3851 (Amount of H2O)
The amount of reactant present on the left and right side of equation (3) is balanced.
The other form of ketones (example Bebzophenone ($C_6H_5COC_6H_5$), Acetophenone ($C_6H_5COCH_3$)) are harmful to living beings therefore using them should be avoided.
Ethyl alcohol (C_2H_5OH) is also used to clean the ceramic samples. It gets evaporates when used ultrasonic waves. It is slow when compared to acetone. The probable reactions to obtain the O2, H2 and CO2 using these alcohols are shown in below equations.

$CH_3OH + 3H_2O$ (moisture or water vapor)$\rightarrow O_2\uparrow + 5H_2\uparrow + CO_2\uparrow$ (catalyzed by ABO_3 material under ultrasonic cleaning). (4)

$C_2H_5OH + 5H_2O$ (moisture or water vapor)$\rightarrow O_2\uparrow + 8H_2\uparrow + 2CO_2\uparrow$ (catalyzed by ABO_3 material under ultrasonic cleaning). (5)

$C_3H_7OH + 7H_2O$ (moisture or water vapor)$\rightarrow O_2\uparrow + 11H_2\uparrow + 3CO_2\uparrow$ (catalyzed by ABO_3 material under ultrasonic cleaning). (6)

$C_4H_9OH + 9H_2O$ (moisture or water vapor)$\rightarrow O_2\uparrow + 14H_2\uparrow + 4CO_2\uparrow$ (catalyzed by ABO_3 material under ultrasonic cleaning). (7)
The calculations of amount of O2, H2 and CO2 from CH_3OH by using equation in reverse order (equation 8) is shown below. It is difficult to obtain the above amounts using direct equations (equation 4)
$O_2\uparrow + 5H_2\uparrow + CO_2\uparrow \rightarrow CH_3OH + 3H_2O$. (8)
31.999*1000/32.04=998.7203 (Amount of O2)
2.061*5*1000/32.04=321.6292 (Amount of H2)
44.01*1000/32.04=1373.5955 (Amount of CO2)
18.01528*1000*3/32.04=1686.8239 (Amount of H2O)
The calculations of amount of O2, H2 and CO2 from C_2H_5OH by using equation in reverse order (equation 9) is shown below. It is difficult to obtain the above amounts using direct equations (equation 5)
$O_2\uparrow + 8H_2\uparrow + 2CO_2\uparrow \rightarrow C_2H_5OH + 5H_2O$ (9)
31.999*1000/46.068=694.6036 (Amount of O2)
2.061*8*1000/46.068=357.9057 (Amount of H2)
44.01*2*1000/46.068= 1910.6538 (Amount of CO2)
18.01528*1000*5/46.068=1955.2921 (Amount of H2O)
The calculations of amount of O2, H2 and CO2 from C_3H_7OH by using equation in reverse order (equation 10) is shown below. It is difficult to obtain the above amounts using direct equations (equation 6)
$O_2\uparrow + 11H_2\uparrow + 3CO_2\uparrow \rightarrow C_3H_7OH + 7H_2O$ (10)
31.999*1000/60.0952= 532.4718(Amount of O2)
2.061*11*1000/60.0952=377.2514 (Amount of H2)
44.01*3*1000/60.0952=2197.0140 (Amount of CO2)
18.01528*1000*7/60.0952= 2098.4531 (Amount of H2O)

The calculations of amount of O2, H2 and CO2 from C_4H_9OH by using equation in reverse order (equation 11) is shown below. It is difficult to obtain the above amounts using direct equations (equation 7)

$O_2\uparrow + 14H_2\uparrow + 4CO_2\uparrow \rightarrow C_4H_9OH + 9H_2O$ (11)

31.999*1000/74.12= 431.7188 (Amount of O2)
2.061*14*1000/74.12= 389.2876 (Amount of H2)
44.01*4*1000/74.12= 2375.0674 (Amount of CO2)
18.01528*1000*9/74.12= 2187.5002 (Amount of H2O)

Polytetrafluoroethylene (PTFE) membrane also called as Teflon membrane may be used to separate the gases (oxygen, hydrogen and carbon dioxide) produced. The membrane can be prepared according to the molecular sizes of oxygen, hydrogen and carbon dioxide. The molecular size of H_2 is 0.120 nm, the molecular size of O_2 is 0.299 nm and the molecular size of CO_2=33.4 nm. To separate out the above three gases PTFE membrane with smaller molecular sizes (H_2 is 0.120 nm) should be prepared and used. Then the next higher molecular size membrane (O_2 is 0.299 nm) should be prepared and used. The third gas carbon dioxide will be separate out automatically as it has higher molecular size (CO_2=33.4 nm).

To make gas permeable through first PTFE membrane with molecular size of H_2 (0.120 nm) pressure should be applied in to chamber which contains the above three gases. Application of temperature will increase the volume of gas. This creates additional pressure in the chamber which leads to permeability of H_2 gas. By using second PTFE membrane with molecular size of O_2 (0.299 nm) the oxygen gas can be separated out. After complete permeable of O_2 gas the gas remained will be carbon dioxide gas.

III. Conclusions:

In the present paper production of oxygen, hydrogen and carbon dioxide using volatile liquids like acetone (CH_3-CO-CH_3), Methyl alcohol (CH_3OH), Ethyl alcohol (C_2H_5OH), Propyl alcohol (C_3H_7OH), butyl alcohol (C_4H_9OH) under the influence of ultrasonic waves are presented. The amount of oxygen, hydrogen and carbon dioxide produced is also presented. The probable procedure to separate out these gases using Polytetrafluoroethylene (PTFE) membrane is also presented. To make gas permeable through first PTFE membrane with molecular size of H_2 (0.120 nm) pressure should be applied in to chamber which contains the above three gases. Application of temperature will increase the volume of gas. This creates additional pressure in the chamber which leads to permeability of H_2 gas. By using second PTFE membrane with molecular size of O_2 (0.299 nm) the oxygen gas can be separated out. After complete permeable of O_2 gas the gas remained will be carbon dioxide gas.

Compliance with Ethical Standards: Yes, the authors followed ethical standards in writing the manuscript.
Funding: Not from funded project from any source and hence funding details are not applicable to this work.
Conflict of interest: The authors declare that they have no conflict of interest

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