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Possibility and determination of the use of CO2 produced by the production of beers

Arsim Elshani[1], Kastriot Pehlivani[2]*, Bakir Kelmendi[3], Ismajl Cacaj[4]

[1,3,4] Faculty of Agribusiness, University of "Haxhi Zeka", Peja, Kosovo
[1,2]J.S.C."Birra Peja", Production Engineering Department, Peja – Kosovo

Abstract

Carbon dioxide, CO_2, causes the greenhouse effect in the earth's atmosphere, and is a product of combustion of organic compounds, for example the methane gas. Carbon dioxide itself does not support burning, and being denser than air it is widely used in fire extinguishers. CO_2 reacts with water producing a weak acid according to the equation: $CO_2 + H_2O = H_2CO_3$.

Alcoholic fermentation is the process of sugar converting into alcohol and carbon dioxide. The actual process, as any beer brewers can attest, occurs over time and involves many chemical reactions. However, the ultimate result is the breakdown of sugar ($C_2H_{12}O_6$), into alcohol ($2C_2H_5OH$) and carbon dioxide (CO_2). If you know the initial quantity of sugar, you can calculate the volume of carbon dioxide that its complete breakdown will produce.

Carbonic gas formed during fermentation of beer. Carbon dioxide can be compressed and as such be used in production again, which at the same time we also protect the environment and cost savings in the process of beer production.

Given that carbon dioxide gas is heavier than air, he sits at the bottom of workspaces, which presents a danger to life.

Keywords: Carbon dioxide, fermentation, beer, recovery.

Introduction

During fermentation in fermentors develops CO_2 to around 3.8 to 4.2 kg per hl of beer. part of the CO_2 stays tied and the beer (0.3 to 0.35 kg / hl), one part of losing washing, and part of mixed with air (0.4 to 0.6 kg / hl) at the beginning of fermentation the discharge the atmosphere or can be used to neutralize waste alkali.[3],[5]

$C_6H_{12}O_6$ ---------- $2C_2H_5OH + 2CO_2$

Stoichiometric shows that from 180 g C6H12O6 simple sugar produced 92 grams of alcohol and 88 grams of carbon dioxide.[9]

CO_2 goes into the processing when the fermentation reached concentrations of 99.5% by volume, and this theory is about 2.8 kg of hl beer. Practice, however, proves to be truly catch and processing of 1.8 to 2.5 kg CO_2/hl beer.[1],[9]

Material and methods

Carbon dioxide (CO_2) formed as a sub product of the main and additional fermentation of beer; CO_2 can compress and as such should be selling or reused in production.[7],[8]

beer
$C_6H_{12}O_6$ ---------- $2C_2H_5OH$ + $2CO_2$ + Energies
Sugar yeast ethyl alcohol
from wort
180gr 92gr 88gr 146.6 kcal

1 hl of produced beer develops cca.3 .2 0.8 to 4 kg of CO_2.
From-Balling during the fermentation of malt extract 1kg produced 0.464kg of CO_2.
Depending on the conditions of fermentation and collection system it is possible to use 1.8 to 2.5 kg CO_2/Hl.[2],[6]

Degradation of the extract		Basic malt extract with 12% of measured value
1days	0.5 %	11.5 %
2 days	1.0 %	10.5 %
3 days	2.0 %	8.5 %
4 days	2.0 %	6.5 %
5 days	1.5 %	5.8 %
6 days	1.0 %	4.0 %
7 days	0.5 %	3.5 %

Amount of CO_2: 100 liters wort gives 1.8 to 2.5 kg of CO_2.[3],[4]

Table 1: The characteristic reactions in relation to the concentration of CO_2

concentration	reaction
3 %	difficulty breathing
7 %	difficulty breathing and fainting
10 %	Suffocation and disorder in the lungs and bloodstream.
20 %	immediate death

Beer saturation with CO_2.

Table 2: Proportion of dissolved CO_2 in beer depending on temperature and pressure

Temperature	Proportion of dissolved CO_2 g/100 g (%)
0	0.335
1	0.321
2	0.309
3	0.298
4	0.287
5	0.277
6	0.268
8	0.249
10	0.232
15	0.197
20	0.169

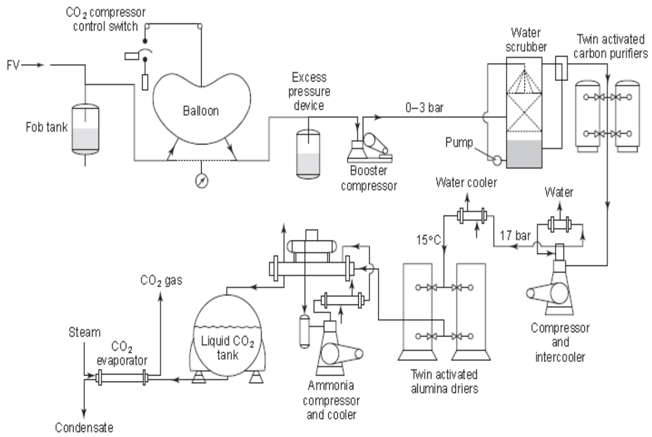
Solubility of CO_2 increases:

- with the lower temperature
- with increasing pressure (Henry's law)

For example:
Solubility of CO_2 in +1 C and:
1.0 bar = 0.321 * 1.0 = 0.321 %
1.1 bar = 0.321 * 1.1 = 0.3531 %
1.5 bar = 0.321 * 1.5 = 0.4851 %
Sales (beer on tap in the packaging) must contain >0.5% (5 g/l) CO_2.

Table 3: Needed CO_2 kg/hl.

Brewery	Bar	Kg CO_2/hl
Storage tank	0.8-1.0	0.35-.050
Pressure Filter (includes pre and follow-pressure water)	1.5-2.5	0.40-0.50
Pressure tank	1.0-1.5	0.30-0.60
machine for filling bottles with the over Pressure Vacuum	1.5-2.5	0.19-0.40
Filling barrels, over pressure	2.0-2.5	0.30-1.10
Filling Cans	2.0-2.5	0.60-0.80
additionally carbonizes	1.5-2.0	0.10-0.20



Picture 1: CO_2 recovery plant.

RESULTS AND DISCUSSION

Budget for the calculation of generated CO_2**.**

Determining the resulting CO_2 cylinder conical fermentor that ferments wort of 2450 hl.

Amount of CO_2 generated during fermentation worts: 100 L 12 % worts give us 1.8-2.5 kg CO_2.[3],[8]

$$Q(CO_2) = \frac{Vs \ X \ St \ X \ p \ X \ Qteor(CO_2) \ X \ Sp}{(t-2) \ X \ 24 \ X \ kg/m3 \ CO_2}$$

Vs-Wort volume in m3 245
St-Wort weight % 12
p-density of the wort kg/m3
Qteor(CO_2)- specific kg CO_2/kg
Ekstakt 0.514 1.140
Sp- wort malt in %
t-Fermentation time in days less 2 6 days
CO_2-density CO_2 kg/m3 1.977

$$Q(CO_2) = \frac{245 \ X \ 12 \ X \ 1.140 \ X \ 0.514 \ X \ 0.65}{(6-2) \ X \ 24 \ X \ 1.977}$$

$Q(CO_2)$ = 58.999 m3N/h

Neutralization, cleaning agents (NaOH) with CO_2.

The first phase $CO_2 + 2NaOH = Na_2CO_3 + H_2O$
pH = 11

Second phase $Na_2CO_3 + H_2O + CO_2 = NaHCO_3$
pH= 7 – 8

1 kg NaOH neutralized 1.1 kg CO_2.

CONCLUSION

Carbon dioxide is produced during fermentation. Because it is heavier than air it collects in the bottom regions of the vessels and spaces.

Because a carbon dioxide content of only 45% can have a fatal effect, carbon dioxide must be removed as it is formed.

A small part of the carbon dioxide formed remains dissolved in the green beer, the remainder escapes.

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