

# PROCESS CONTROL FOR SULFUR DIOXIDE IN BEER: POST-FERMENTATION & GAUGE

## Post-Fermentation

**Simpson found the 1/2 life of SO<sub>2</sub> in beer ranged from 30-220 days at room temperature! Most common was 170-180 days!**

**Photoxidation (-)**.....exposure of packaged beer to 600 ft<sup>2</sup> candles of light....see 20% drop in SO<sub>2</sub> over 20 hours, then [SO<sub>2</sub>] stabilizes. In turn, this causes a 30% decrease in beer ESR lagtime from 47 minutes to 33 minutes.

Pressure release in aging, fassed beer (-)

**Beer D.O. (-)**

Higher package beer storage temps (-)

**Pasteurizing (-)**

While well documented, decline of [SO<sub>2</sub>] in packaged beer poorly understood, believe it reacts with other beer components such as proteins or PPs.

**Beer handling/transfers (-)**

By binding carbonyls, SO<sub>2</sub> mask their flavors as threshold for the free carbonyls are much lower.

**CO<sub>2</sub> purging of H<sub>2</sub>S (-)**

EBC: standard analysis method is distillation based on a Monier-Williams method.

## Gauge

**"Detector" membranes** impregnated with iodine-starch solutions....the blue I<sub>2</sub>-starch complex is decolorized by SO<sub>2</sub>.....simple wells format. Also can have wells on same device impregnated with silver nitrate solution for H<sub>2</sub>S and in one test, compare relative levels of both!

BRI: 13 ppm SO<sub>2</sub> in package decreased to 4 ppm over 44 weeks at room temperature.

**Miller: ESR lag time times correlate well with SO<sub>2</sub> levels, but not sensory results!!!!!!**

## Sulfur Dioxide Levels in Beer

Structure is pH dependent with following forms:  
SO<sub>2</sub>·H<sub>2</sub>O loosely hydrated undissociated form over pH 0-2.....at usual pH's of beer, most of the SO<sub>2</sub> is present as as the bisulfite or hydrogen sulfite ions HSO<sub>3</sub><sup>-</sup> form over pH 2-8.....then SO<sub>3</sub><sup>2-</sup> from > pH 8.0.  
From acidic to basic pH's progresses from sulfur dioxide to sulfurous acid (H<sub>2</sub>SO<sub>3</sub>) to bisulfite ion (HSO<sub>3</sub><sup>-</sup>) to sulfite ion (SO<sub>3</sub><sup>2-</sup>) as follows:  
 $SO_2 \cdot nH_2O \dots SO_3^- + H_3O^+ \dots SO_3^{2-} + 2H_3O^+$

- Assays include:
- Classic Monier-Williams colorimetric procedure with para-rospaniline as in ASBC MOA....carcinogenic....measure at 550 nm....relatively high R&R at < 10 ppm
  - Improved Monier-Williams by FDA with better R&R below 10 ppm;
  - Colorimetric method using DTNB used as the color agent after the distillation step....recommended for total SO<sub>2</sub> by EBC....measure at 415 nm;
  - FIA systems using either malachite green or p-rospaniline.....wide use in wine industry;
  - Enzymatic using sulfite reductase approved by EBC ...based on oxidation of NADH by H<sub>2</sub>O<sub>2</sub> formed during the oxidation of sulfite by the action of sulfite oxidase...measure at 340 nm;
  - Flame photometric detection (FPD) and GC methods, including chemiluminescence sulfur detector ....better than colorimetric based for dark beers;
  - Pulse polarography
  - Ion exclusion chromatography eith ECD simpler & good correlation with colorimetric methods ..... good R&R at even the 0.5 ppm level;
  - Next one? Still no "perfect" assay.

**Labatt: DTNB safer than para-rospaniline for measuring SO<sub>2</sub> levels in the lab.**

**"Free SO<sub>2</sub>" = difference between the total SO<sub>2</sub> and acetaldehyde concentrations.**

**Flavor threshold of free SO<sub>2</sub> is @ 25 ppm.**

Sulfites are measured and expressed as sulfur dioxide.

EU regulations for SO<sub>2</sub> are < 10 ppm before labelling required; limits of 20 ppm of total SO<sub>2</sub> in low-alcohol and alcohol free products; limit of 50 ppm in cask-conditioned products.

**ASBC No. XVIc  
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## Gauge

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