

## Effect of processing and sawing techniques on the measurement of aerosolized formaldehyde from cutting bone tissue samples:

Sadegh Nikfarjam, Hussein Alizereej, and Morhsed Khandaker, Ph.D.

Department of Biology and Department of Engineering and Physics, University of Central Oklahoma

### INTRODUCTION:

Pathology band saws are designed for histopathology laboratories for cutting hard tissue (e.g., bone, cartilage) and soft tissue (e.g., liver, spleen) and metal/ceramic/plastic/composite implants with tissues. As hospitals and other pathology facilities process tissue samples in formaldehyde solution, it produces aerosolized formaldehyde (HCHO) in the air during the cutting process of the tissue samples. Containment of aerosols during cutting of any of the above samples is an environmental and health safety issue. No study has quantified the amount of aerosolized formaldehyde that is released before and after cutting bone and tissue using a pathology band saw. And there is no research looking at techniques such as blade material, thread, and water circulation affect of HCHO emission from cutting time. Therefore, the objectives of this study are to measure the level of formaldehyde produced during the processing of the sample (before cutting using the saw machine) and to measure the effect of sawing techniques on HCHO emission rate from the cutting of formaldehyde-soaked bone.

### MATERIALS & METHODS:

This study used a general-purpose butcher band saw, which is a non-water cooled and tooth-set blade saw (Model# Omcan, 0.635 mm thickness, 4 Teeth Per Inch) and an EXAKT 300 band saw, which is a water-cooled

and diamond coated blade saw (0.2 mm thickness). Goat femur bone tissues were obtained from a local butcher shop and fixed in 10% formalin solution for long (>6 months) and short periods (24 hours). Bones were then cut in two different conditions (with and without vacuum pressure in a hood) for the butcher saw machine and without the hood using the EXAKT 300 diamond saw machine. EXTECH Formaldehyde Meter measured aerosolized formaldehyde before and after cutting the bone, which was held 50 cm from the saw machines. The experiment was conducted three times, and the average result was reported after 1,2, 3,4, 5, 10 minutes time intervals.

**TABLE 1: Total Volatile Organic Compound (TVOC) level of concern**

Commonly used pathology band saw: (a)non-water cooled and teathed blade, (b)water-cooled and diamond coated blade

TVOC level (mg/m3)	Level of concern
Less than 0.3	Low
0.3 – 0.5	Acceptable
0.5 – 1	Marginal
1 – 3	High

**RESULTS:**

According to Occupational Safety and Health Administration (OSHA) (Table 1), the permissible exposure limit (PEL) for formaldehyde in the workplace is 0.75 parts formaldehyde per million parts of air (0.75 ppm) measured as an 8-hour time-weighted average. Our study found bone tissue soaking period influences the HOCO emission rate. Although a high level of HOCO emission was observed for both long and short-term soaked samples, a sample stored in HOCO for 24 hrs emits less HOCO compared to samples stored for a long period (Fig 2). The average HOCO emission for butcher saw machine was revealed to be greater than 0.5 ppm without hood and 0.13 ppm under vacuum pressure in a hood (Fig. 3). The HOCO emission from the EXAKT 300 saw showed 0.18 ppm without hood pressure that was measured over 10 minutes after cutting the samples.

**DISCUSSION:**

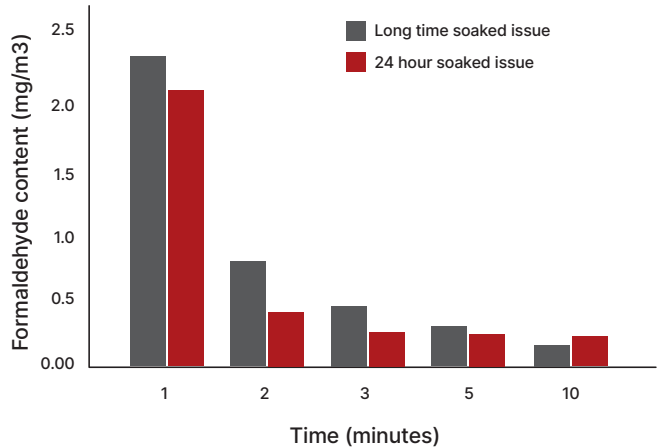
Based on the above results, the butcher saw machine without the hood showed a high level of concern with HCHO emission value higher than acceptable health risk value, where under vacuum pressure in the hood, the level of HOCO emission was low. The study results for the pathology diamond saw machine show around 0.18 ppm without hood that counts as a low level of concern for 10 minutes after sawing the samples.

**SIGNIFICANCE:**

High risk of HOCO emission occurs during the histology process before and after cutting the tissue samples using a regular purpose band saw without a hood. The safest cutting technique for cutting bone and tissue samples would be using EXAKT 300 as the low level of formaldehyde was measured without hood condition.

**FIGURE 2:**

**HOCO emission from bone tissue with time upon opening the lid of a container storing the bone tissue at different periods.**



**FIGURE 3:**

**HOCO emission from bone tissue with time after cutting the tissue using non-water cooled and teethed blade without and with vacuum pressure and water-cooled and diamond coated blade without vacuum pressure.**

