A new method for casting three dimensional shoeprints and tire marks using dental stone

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Introduction

Historical Milestones:

1858 – Plaster of Paris first used for casting three dimensional shoeprints.
1950 – Dental stone was introduced as a replacement for Plaster of Paris.
1984 – The use of the re-closable (zip-lock) bag method for mixing dental stone and water is wide-spread.

For several decades, dental stone has been used as the major material for recovering three dimensional shoeprints and tire track marks from crime scenes. The procedure has changed very little over the years. Today there are two methods for mixing dental stone: (1) a pre-measured amount of dental stone is put in a zip-lock bag to which water is added (2) a pre-measured amount of water is poured into a bucket. The dental stone is added to the water.
The novel method presented here – 'the bottle method' is simple and fast, and the quality of the prints is at least as good as that produced by the two other methods.

Method

Several cuts were made on the shoe-sole surface of a brand new shoe. The cuts varied in size and shape.
The shoeprints were imprinted in Biofoam® and in fine clay soil to preserve the fine details.

Fig. 1: The experiment array

The mixing methods applied:

The 'Re-closable bag' method

Water was added to the dental stone in a "Zip-lock" bag. The casting material was then mixed by massaging and kneading the bag for 50 seconds until the water and the dental stone were completely mixed.

The 'bucket' method

Water was poured into a bucket. The dental stone was added to the water and then allowed to settle and soak for 2 minutes. The mixture was stirred thoroughly for 4 minutes.

The 'bottle' method

Water was added to the dental stone in a 1.5 liter bottle. The bottle was turned upside down for app. 30 seconds until all the powder was soaked with water. The closed bottle was vigorously shaken for 3 min.

Measured parameters

1. Drying duration

The temperature of each cast was measured during the drying process (Fig. 1). The end of the process was determined as the time the cast reached room temperature.

2. Amount of air bubbles

Air bubbles were counted on the elements of the sole pattern (Fig. 2). The air bubbles were divided into two groups, smaller than 0.5mm or larger.

3. Comparison of the impression with the shoe.

Comparison was performed between the casts made by the three methods, with special attention to the quality of the individual characteristics (Fig. 5).

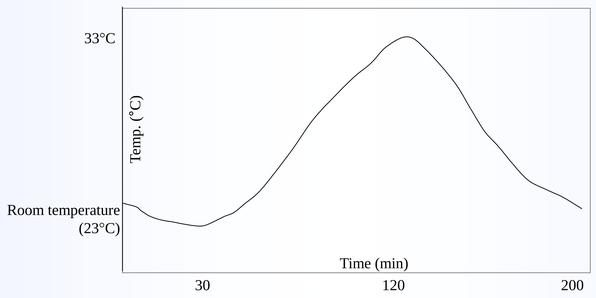
Fig. 2: Shoe ⟷ Impression

Results

Temperature variation:

The temperature variation during the casting mixture setting time was measured (Fig.3). No significant differences between the three methods were observed and the total setting time was approximately 3 hours.

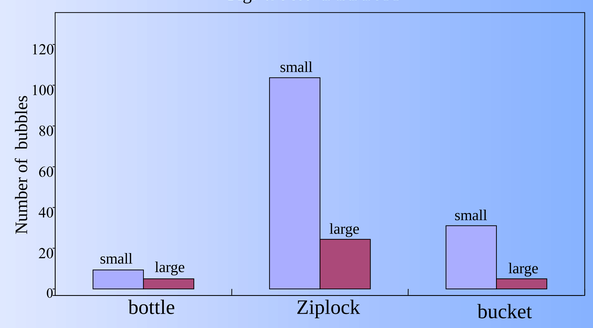
Fig. 3: Temperature change during cast drying



Air bubbles:

The size of most air bubbles was less than 0.5 mm, for all mixing methods. Surprisingly, the amount of air bubbles with the zip-lock method was significantly higher than the other two methods. With the bottle method, not many air bubbles were present despite the vigorous mixing.

Fig. 4: Air bubbles

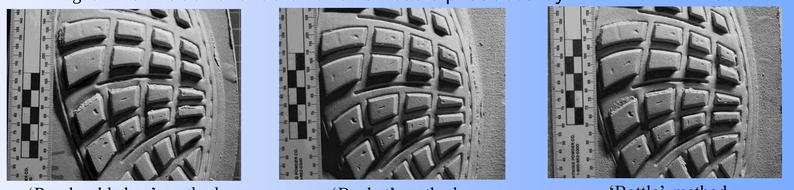


Counting trapped air bubbles suggests that the 'bottle' method is not inferior to the traditional methods, possibly even superior to them. The appearance of large air bubbles was rare with all three methods, yet the average number of small bubbles was much higher on casts prepared with the 're-closable bag' method (Fig. 4).

Unique features:

The results of the unique features comparison were method dependant. While the 're-closable bag' method appeared inferior to the other methods, the bucket and the bottle seemed to achieve similar results. The fine details of the minutiae were extremely sharp with the 'bucket' and the 'bottle' methods, but were sometimes vague with the 're-closable bag' method.

Fig. 5: Individual characteristics on casts produced by the three methods



'Re-closable bag' method | 'Bucket' method | 'Bottle' method

References:

Bodziak W.J. Footwear impression Evidence, Detection Recovery and Examination. 2nd Ed., CRC press Washington D.C, 2000.

Conclusions

The zip-lock method is the predominant method used today due to its simplicity and ease of use. the quality of the casts produced is inferior to the 'bucket' method. The 'bottle' method seems to give much better results than the 're-closable bag' while even improving the ease and comfort of use.
The quality and hardness of the cast are directly related to the amount of energy that goes into mixing. The energy is derived directly form the vigorousness of mixing. Since shaking the bottle is much more vigorous than mixing with the two other methods, the casts produced are probably stronger.

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