

# Analysis of Granules and Hardness on Metal Alloys

## 77 % Cu 23 % Zn

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**Abstract:** This analysis is designed to observe sum, hardness, and number of grains. Grain refinement is one solution to reducing damage caused by heating. The sample of alloys, Cu 77% - Zn 23%, 50 mm in diameter, was analyzed using Optic Microscope and Buehler Micro Hardness. Experiments suggest the amount of grain is 5824 grains/mm<sup>2</sup>, large number of grain (ASTM G), 9.558, and mean hardness, 123.506 HV.

**Keyword:** Alloy, Cooper, Grain, Micro hardness, Optic microscope, Zinc

### 1. Introduction

The observation of a material using optic microscope will support in doing analysis of micro material structure. Based on the observation, we found sum and large number of grain. The observation is carried out by using optic microscopic medium having the range of resolution up to 1900A and amplification ranging from 4x to 1000x. Using standardized ASTM, the visual observation of grain is put in mathematical process to find sum of grain. The hardness of a material offer information on the type of material than did standardized data. Hardness is resistance of a material to a penetration over the occurrence of plastic deformation. Grain refinement is one solution to reducing damage caused by heating [1]

### 2. Experimental

#### 2.1 Material Preparation

Metal was cut using saw machine into two, pieces are mold in holder using resin and hardener in comparison of volume 10:2. The surface of mold is polished in phase of coarseness SiC paper 320; 500; 800; 1000; 2000, and finishing is made by diamond compound 3µm. After sample has been polished, it is washed in a 4 ml HNO<sub>3</sub> + 96 ml Ethanol solution.

#### 2.2 Granules Testing

The tests of granules were conducted by using optical microscope type NIKON, Model Optiphot 2708525 with the objective lens 1.5X to 400X, Stroke 32 mm, Fine focusing 5.2 mm/rotation, Magnification 12X to 3,000X, Power supply AC220-240V±10% 50/60Hz, Lamp 12V-50W Halogen. The resulting image is recorded on computer.

#### 2.3 Hardness Testing

The tests of hardness were conducted by using Micro hardness type BUEHLER, Model Indenta Met 1110, Dead weight 200 gf, Load mechanism Leaf spring, release at 50µm/sec, Objective lens 10x, 40x objective, Specimen height 90 mm (max), Specimen depth 110 mm (max), Hardness scale Vickers (HV), Knoop (HK), X-Y Stage

Manual, Precision vise 50 mm max opening, Light source 12V50W, Standart ASTM E-384, ISO 6507-2.

Brinnell hardness value is calculated by,

$$HV = \frac{1,854 \times P}{d^2} \quad (1)$$

$$d = \frac{d_1 + d_2}{2} \quad (2)$$

Where:

P = Load pressure (kgf)

d<sub>1</sub> = The first diagonal length (mm)

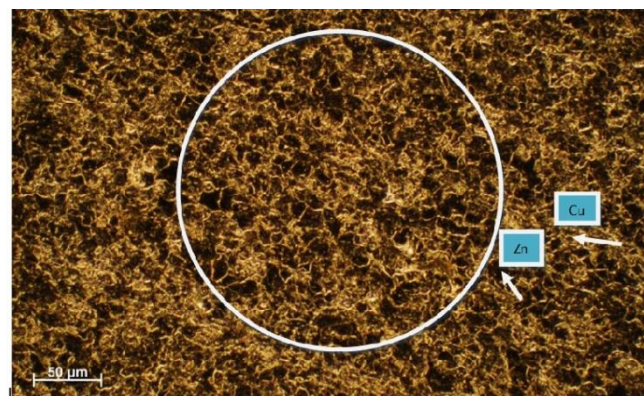
d<sub>2</sub> = The second diagonal length

d = Average length (mm)

### 3. Results and Discussion

#### 3.1 Grain

The experiment of grain using optic microscope [2] was analyzed to find sum of grain per area unit and size as shown in the following figure.



**Figure 1:** Observations on the granules with 200x Magnification

The calculation of the number of grains

Diameter circle = 79.8 mm

Magnification = 200X

The number of grains in the circle (n<sub>1</sub>) = 56

The number of grains outside the circle ( $n_2$ ) = 26

Planimetri factor ( $f$ ) = 8

Area of a circle

$$A = \pi \cdot 39,9^2 = \pi \cdot \text{mm}^2 = 1592.01 \text{ mm}^2$$

Number of grains / mm<sup>2</sup>

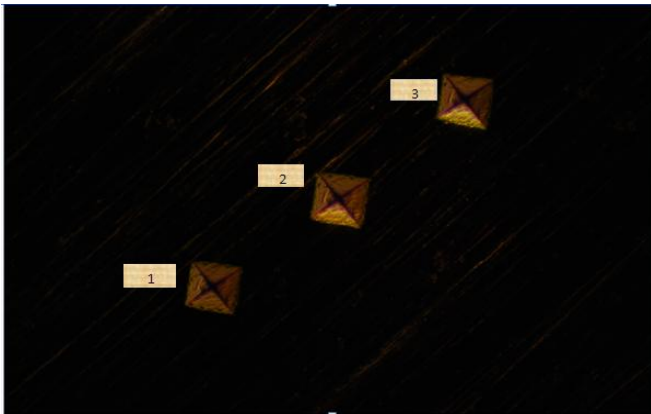
$$N_A = f \left[ n_1 \frac{n_2}{2} \right] = 8 \left[ 56 \frac{26}{2} \right] = 5824$$

A large number of granules (ASTM G)

$$G = [3,322 \log(N_A) - 2,95] = 9.558$$

### 3.2 Hardness

The sample is subjected to hardness test using Micro Hardness [3] in some points as mentioned below.



**Figure 2:** Observations on hardness with 200x Magnification

Each of tracking points was counted in hardness by using equations (1) and (2).

Results were depicted as in Figure 5 and calculations were listed as in Table 2.



**Figure 3:** Measurement of observations

**Table 2:** The results of hardness

No	d <sub>1</sub> (mm)	d <sub>2</sub> (mm)	Kekerasan Vickers (HV)	Kekerasan Rata-rata (HV)
1	0.049	0.048	131.636	
2	0.052	0.050	116.561	123.503
3	0.048	0.052	122.320	

### 4. Conclusions

Trials suggest mean hardness is 123.506 HIV and experiment of grain represent sum of grain is 5824 grain/mm<sup>2</sup>, and large number of grain based on ASTM E112 is 9.558.

### References

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