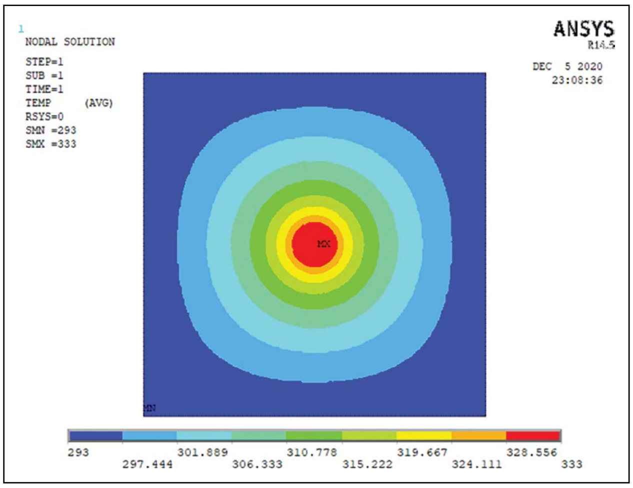

Figure 3. Effective thermal conductivity model for Batman's stone.

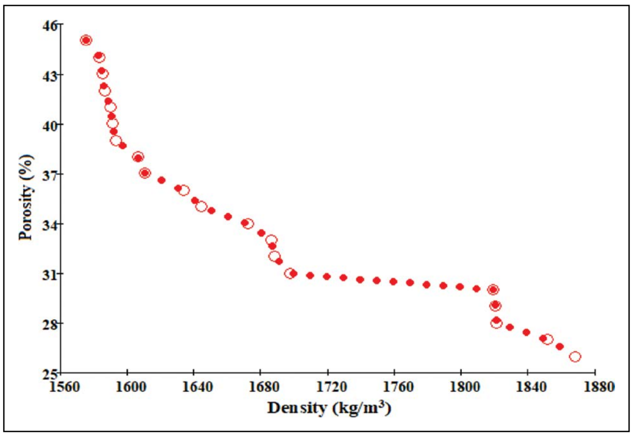

Figure 4. Variation of the porosity of the stone in Batman region with density.

As seen in Figure 4, as the density of the stone extracted from the mine in Batman region increased, its porosity decreased. The density and size of the pores in the mineral stone and the mineral structure of the stone directly affect the density. As the number of pores and the size of the pores increase, the gas density within the rock will also increase. Accordingly, the effective thermal conductivity of the rock increased, as can be seen in Figure 5. Because the thermal conductivity of minerals in rock is much higher than in gases.

Shore D hardness test samples, as can be seen in the graphic in Figure 6, it was observed that the hardness generally increased as the density increased. According to the results obtained in Batman stone, it was seen that Shore D hardness increased as the density increased. In the literature research, it has been observed that as the density of these stones increases, both their mechanical strength and hardness increase [14, 15]. Figure 7 shows the variation of Batman's stone capillary coefficient calculated with the help of Eq. (8) with its bulk density.

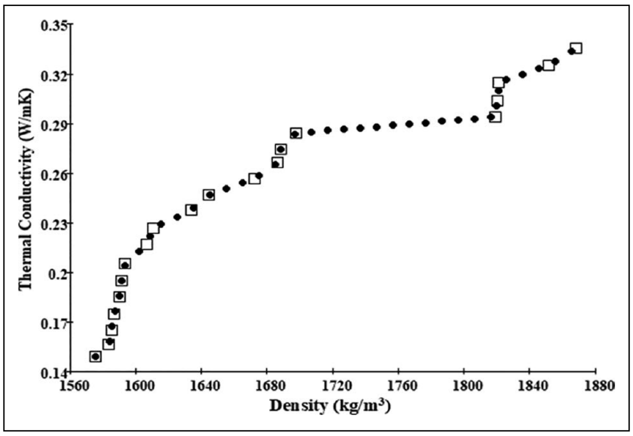

Figure 5. Variation of the thermal conductivity of the stone in Batman region with density.

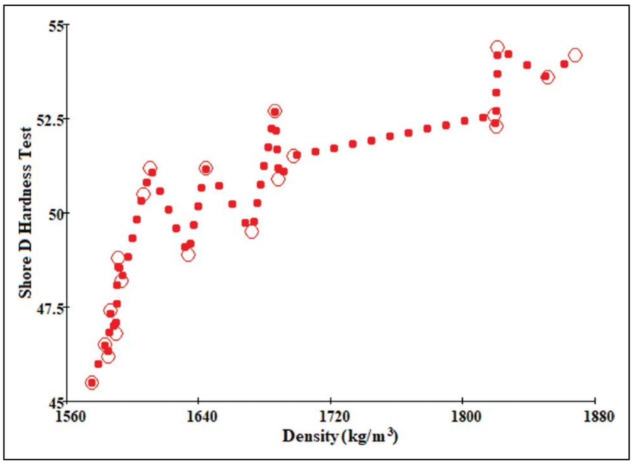

Figure 6. Variation of Shore D hardness test of the stone in Batman region with density.

CONCLUSIONS

Some physical and chemical properties of stones extracted in Batman region were determined in this study. In particular, it has been observed that the density of these stones varies according to the chemical composition, pore structure, and distribution. Shore D hardness of stones with density of 1560 kg/m^3 to 1880 kg/m^3 showed an increasing trend from 45 to 55. It was observed that the capillarity coefficient and thermal conductivity coefficient increased with the increase in density. While the heat conduction coefficient is 0.14 W/m·K at low densities, it has increased up to 0.35 W/m·K at high densities. When compared with the studies conducted with the stones in the Southeastern Anatolia region, it was observed that the heat conduction coefficient values gave compatible results. When compared with the studies conducted with the stones in the Southeastern Anatolia region, it was observed that the thermal conductivity coefficient values gave compatible results [16].

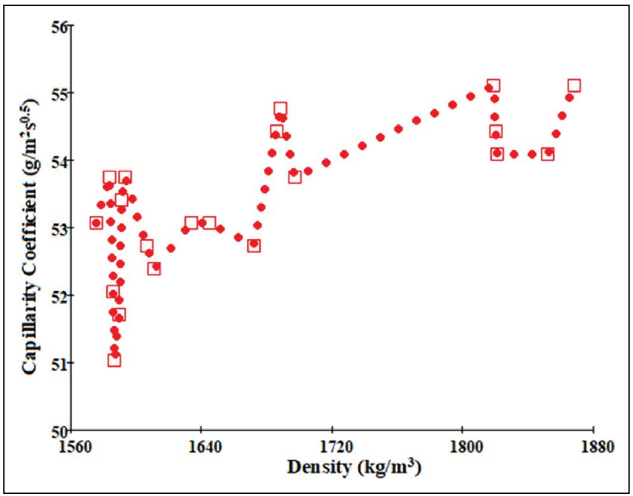

Figure 7. Variation of the capillarity coefficient of the stone in Batman region with density.

In addition, the porosity of Batman stone decreased from 45% to 25% with increasing density. The thermal conduction coefficient has changed according to the solid and gas phase ratios in the stone. Gases, moist areas, and solid minerals in the stone affect the thermal conduction coefficient. The results found in the mechanical tests show that these stones comply with the standards according to the intended use in the construction industry. The fact that Batman's stone is economical and its use for decorative purposes will increase its value in the future. In addition, some physical and chemical properties of this stone were characterized by experimental studies, theoretical models, and statistical analysis.

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AUTHORSHIP CONTRIBUTIONS

Authors equally contributed to this work.

DATA AVAILABILITY STATEMENT

The published publication includes all graphics and data collected or developed during the study.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICS

There are no ethical issues with the publication of this manuscript.

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