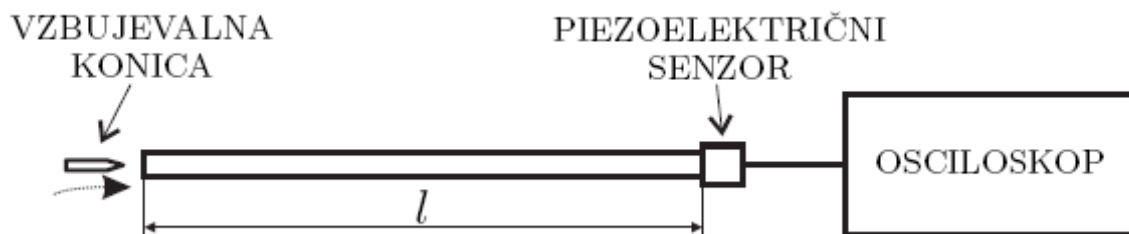


## Vaja 10: Hitrost zvoka v palici

Skica poskusa:



Uporabljene enačbe:

$$c_{izr} = \sqrt{\frac{E}{\rho}}$$

$$c_{izm} = \frac{n2l}{t_n}$$

$$\Delta l = l\alpha\Delta T$$

$$\Delta t_n = \frac{\Delta l}{c}$$

Rešitev naloge:

1.

Medenina

$$c_{izr} = \sqrt{\frac{E}{\rho}} = \sqrt{\frac{90\text{GPa}}{8600\text{ kg/m}^3}} = \underline{\underline{3235,0 \frac{\text{m}}{\text{s}}}}$$

$$c_{izm} = \frac{n2l}{t_n} = \frac{10 \cdot 2 \cdot 1,514\text{m}}{9\text{ms}} = \underline{\underline{3364,4 \frac{\text{m}}{\text{s}}}}$$

## Jeklo

$$c_{izr} = \sqrt{\frac{E}{\rho}} = \sqrt{\frac{210 \text{ GPa}}{7850 \text{ kg/m}^3}} = \underline{\underline{5172,2 \frac{\text{m}}{\text{s}}}}$$

$$c_{izm} = \frac{n2l}{t_n} = \frac{11 \cdot 2 \cdot 1,5 \text{ m}}{6 \text{ ms}} = \underline{\underline{5500,0 \frac{\text{m}}{\text{s}}}}$$

| snov                        | medenina | jeklo  |
|-----------------------------|----------|--------|
| $l$ [mm]                    | 1515     | 1500   |
| $t_n$ [ms]                  | 9        | 6      |
| $n$                         | 10       | 11     |
| $E$ [GPa]                   | 90       | 210    |
| $\rho$ [kg/m <sup>3</sup> ] | 8600     | 7850   |
| $c_{izm}$ [m/s]             | 3364,4   | 5500,0 |
| $c_{izr}$ [m/s]             | 3235,0   | 5172,2 |

2.

## Medenina

$$\frac{c_{izr} - c_{izm}}{c_{izm}} = \frac{3235,0 \frac{\text{m}}{\text{s}} - 3364,4 \frac{\text{m}}{\text{s}}}{3364,4 \frac{\text{m}}{\text{s}}} = \underline{\underline{-0,0385 = -3,85\%}}$$

## Jeklo

$$\frac{c_{izr} - c_{izm}}{c_{izm}} = \frac{5172,2 \frac{\text{m}}{\text{s}} - 5500,0 \frac{\text{m}}{\text{s}}}{5500,0 \frac{\text{m}}{\text{s}}} = \underline{\underline{-0,0596 = -5,96\%}}$$

Do razlik prihaja, ker material ni idealn ter nenatančnosti pri merjenju. Do boljših rezultatov bi prišli, če bi pri večih meritvah izračunali srednjo vrednost.

3.

$$\Delta T = 10K$$

$$l_{medenina} = 1,514m$$

$$l_{jeklo} = 1,5m$$

$$c_{medenina} = 3235,0 \frac{m}{s}$$

$$c_{jeklo} = 5172,2 \frac{m}{s}$$

$$\alpha_{medenina} = 1,8 \cdot 10^{-5} K^{-1}$$

$$\alpha_{jeklo} = 1,2 \cdot 10^{-5} K^{-1}$$

$$\Delta l = l\alpha\Delta T$$

$$\Delta t_n = \frac{\Delta l}{c}$$

$$\Delta t_{medenina} = \frac{l_{medenina} \alpha_{medenina} \Delta T}{c_{medenina}} = \frac{1,514m \cdot 1,8 \cdot 10^{-5} K^{-1} \cdot 10K}{3235,0 \frac{m}{s}} = \underline{\underline{84ns}}$$

$$\Delta t_{jeklo} = \frac{l_{jeklo} \alpha_{jeklo} \Delta T}{c_{jeklo}} = \frac{1,5m \cdot 1,2 \cdot 10^{-5} K^{-1} \cdot 10K}{5172,2 \frac{m}{s}} = \underline{\underline{34ns}}$$

Medenina

$$\frac{n \cdot \Delta t}{t_n} = \frac{10 \cdot 84ns}{9ms} = \underline{\underline{0,000093}} = 0,0093\%$$

Jeklo

$$\frac{n \cdot \Delta t}{t_n} = \frac{11 \cdot 34ns}{6ms} = \underline{\underline{0,000062}} = 0,0062\%$$