Find the value of current through a capacitor of capacitance 10 μF, when connected to a source of 110 volt at 50 cycles supply. What is its reactance?

Solution.

$$\mathrm{C} = 10\mu F$$

$$E = 110V$$

$$\nu = 50Hz$$

Increasing the frequency will also decrease the opposition offered by a capacitor. This occurs because the number of electrons which the capacitor is capable of handling at a given voltage will change plates more often. As a result, more electrons will pass a given point in a given time (greater current flow). The opposition which a capacitor offers to ac is therefore inversely proportional to frequency and to capacitance. This opposition is called **CAPACITIVE REACTANCE**.

You may say that capacitive reactance decreases with increasing frequency or, for a given frequency, the capacitive reactance decreases with increasing capacitance. The symbol for capacitive reactance is X_C.

To find capacitive reactance used the formula:

$$X_c = \frac{1}{C\omega}$$

$$\omega = 2\pi\nu$$

Thus

(Take $\pi = 3.14$)

$$X_c = \frac{1}{2\pi\nu C} = \frac{1}{2 \cdot 3.14 \cdot 50 \cdot 10 \cdot 10^{-6}} = 318.5\ \Omega$$

$$I = \frac{E}{X_c} = \frac{110V}{318.5\Omega} = 0.345A$$

$$I_{max} = \sqrt{2}I = 1.4 \cdot 0.345 = 0.483A$$

This current oscillates between $+0.483A$ and $-0.483A$. It is ahead of the voltage by $90°$. If the frequency is doubled, the capacitive reactance is halved and consequently, the current is doubled.

Answer:

Capacitive reactance:

$$X_c = 318.5\Omega$$

Current:

$$I = 0.345A$$