PROBLEM 1.62(b)

KNOWN: Physical mechanism for microwave heating.

FIND: Comparison of (i) cooking in a microwave oven with a conventional radiant or convection oven and (ii) a microwave clothes dryer with a conventional dryer.

(i) Microwave cooking of food that contains water molecules occurs as a result of volumetric thermal energy generation *throughout* the food, without heating of the food container or the oven wall. Conventional cooking relies on radiant heat transfer from the oven walls and/or convection heat transfer from the air space to the surface of the food and subsequent heat transfer by conduction to the core of the food. Microwave cooking can be achieved in less time.

Heat loss from a microwave oven will likely be less than from a conventional oven. However, microwave cooking requires an electrical source of energy while the conventional oven can use, for example, natural gas. If the electricity for the microwave oven is generated by burning natural gas in a large power plant, the conventional natural gas oven will be more efficient than the microwave oven when the relatively low efficiency of the power plant is taken into account.

(ii) In a microwave dryer, the microwave radiation would heat the water, but not the fabric, directly (the fabric would be heated indirectly by thermal energy transfer from the water). By heating the water directly, energy would go directly into evaporation, unlike a conventional dryer where the walls and air are first heated electrically or by a gas heater, and thermal energy is subsequently transferred to the wet clothes. The microwave dryer would still require a rotating drum and air flow to remove the water vapor, but is able to operate more efficiently and at lower temperatures if the comparison is made to a conventional electric dryer.

If comparison is made between the microwave dryer and a conventional dryer fueled by, for example, natural gas, the conventional dryer can be more efficient than the microwave dryer when the relatively low efficiency of the power plant is taken into account.