Electrostatic precipitator

See Fig. 23-35, p. 904

radius of cylinder 14.0 cm

radius of central wire is 90 μm = 9 x 10⁻⁶ m

50.0 kV power source

- Remove pollutants from smokestacks at coal burning plants - like TVA!

(a) What is \( \overrightarrow{E} \) midway between wire and cylinder wall?

Hint: in problem is to look at prob. 23-57 about coaxial cylinders. Some as for 23-58 problem.

\[
E = \frac{V_{ab}}{\ln \left( \frac{b/a}{\ln (b/a)} \right)}
\]

for this case.

with \( b \) = tube outer radius

\( a \) = inner wire radius

\[
E = \frac{5 \times 10^4}{\ln \left( \frac{0.140}{9.0 \times 10^{-5}} \right)} \text{ V/m}
\]

\[
E = 9.72 \times 10^4 \text{ V/m}
\]

(b) What is magnitude of charge needed on a 30 μg ash particle if the \( E \) above is to have a force of 10 times the weight of the fly ash? (to get it to move toward the collector)

Remember \( F = qE = ma = mg \). We want \( F = 10 \text{ mg} \)

\[
9E = 10 \text{ mg} \Rightarrow q = \frac{10 \text{ mg}}{E} = \frac{(10)(30.0 \times 10^{-9} \text{ kg})(9.8 \text{ m/s}^2)}{9.72 \times 10^4 \text{ V/m}}
\]

\[
q = 3.02 \times 10^{-11} \text{ C}
\]