The problem can be solved by using results on fundamental electrostatics. It is suffices to note that the equipotential surfaces corresponding to charged parallel lines are always cylinders.

The solution appears on several bocks devoted to electromagnetism:

1. E. Duran, Electrostatique, vol II, Problemes Generaux Conducteurs, page 191.
2. D. K. Cheng, Field and Wave Electromagnetics, Example 4-4
3. R K Wangsness, Electromagnetic Fields, chapter 11
4. B D Popovic, Introductory Engineering Electromagnetics, page 144

The capacitance per unit length is:

$$\frac{C}{l} = \frac{\pi\varepsilon_0}{\ln\left[\left(\frac{D}{2a}\right) + \sqrt{\left(\frac{D}{2a}\right)^2 - 1}\right]},$$

or, alternatively, in the most usual form:

$$\frac{C}{l} = \frac{\pi\varepsilon_0}{\operatorname{arcosh}\left(\frac{D}{2a}\right)},$$

where D represents the distance between the centres of the wire and a the wire radius.

For cases in which the wires are at a great distance apart, $D >> a$, we can find the approximate equation:

$$\frac{C}{l} \approx \frac{\pi\varepsilon_0}{\ln\left(\frac{D}{a}\right)}.$$

In the figure the dependence of the capacitance per unit length (*F/m*) versus the wire distance (*m*), for wire radius $a = 10^{-3}m$, is shown. Note, how the capacitance increases quickly when the wires are almost in contact ($D \approx 2a$). (Also note, that in the function arcosh(x), the argument x should be larger than 1, and arcosh(1)→0). We show also the approximation that fit very well the exact expression when $D >> 2a$.