Determining the Thickness of Zinc on Galvanized Washers – FS06

A. Calculations:
1. Mass Change – Subtract the final mass from the initial mass.
2. Volume of Zinc Coating –
    Mass Change (Answer from #1) ÷ Density of Zinc $\qquad$ where d_{zinc} = 7.14 g/cm^3
3. Area of Zinc Coating –
$$2\,\pi\,(r_o^2 - r_i^2) + 2\,\pi\,r_o\,h + 2\,\pi\,r_i\,h$$
    where
    - r_o is the outer radius of the washer;
    - r_i is the inner radius of the washer; and,
    - h is the height of the washer.

    (***Don't forget to convert the measured diameters to radii.)
4. Thickness of Zinc Coating (cm) –
    Volume of Zinc Coating (Answer #2) ÷ Area of Zinc Coating (Answer #3)
5. Thickness of Zinc Coating (atoms)

    Zinc (cm)   x $\dfrac{1\ \text{meter}}{100\ \text{cm}}$ x $\dfrac{1 \times 10^{12}\ \text{pm}}{1\ \text{m}}$ x $\dfrac{1\,\text{atom Zn}}{268\ \text{pm}}$

B. Calculate the Mean, Standard Deviation and Confidence Interval (98%) for the Volume, Area and thickness of Zinc in atoms.
1. Go to pages 9-10 in your lab manual.
2. The mean for the volume, for example, is simply the 5 volumes you calculated divided by 5 (Eqn 1).
3. For the standard deviation (Eqn 3):
    a. You have to then subtract the average from each of the observations.
    b. The value you calculated in a is then squared.
    c. The value you calculated in b is divided by the number of degree of freedom
        (i.e. the number of observations minus one) in this case divide by 4.
    d. Finally square root the value calculated in c, this is your standard deviation, s.
4. The Confidence Interval CI (98%) Single Value (Eqn 4)
    a. Take the value you calculated for Eqn 3 this is your "s"
    b. Look at the table on the bottom of page 10, scroll down the degrees of freedom
        until you get to...4. Then go to the 98% column and get the number value.
        This number is your "t"
   c. multiply t x s to get your value for CI.
5. The Confidence Interval CI (98%) Mean (Eqn 5).
    a. Take the value you calculated in Eqn 4 and divide by the square root of n – this is your CI Mean.
6. Repeat these steps for the Surface Area and the Thickness of Zinc

C. Graphs of the Volume, Area and thickness of Zinc in atoms.
1. In Excel (or any program that will make graphs), make column graphs where the washers and the average washer are listed on the x axis and their volumes (area, thickness) are listed on the y axis. Do not forget to include units. (Note: Volumes in graph below were arbitrary and do not reflect your expected results.)
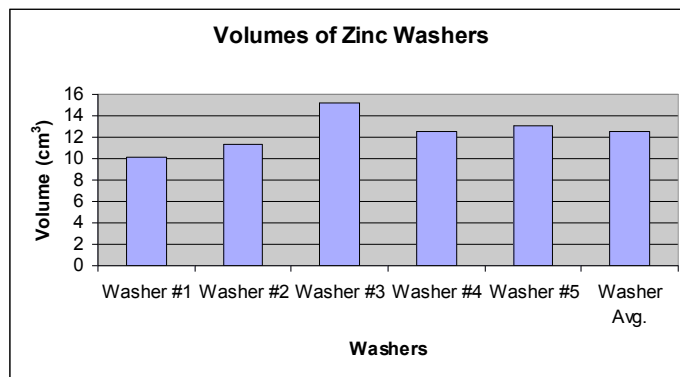
D. Turn-in to be graded:
1. Data and Results Sheet and 3 Graphs.
2. Sample Calculations for Washer #1: volume, area, thickness of zinc in cm and in atoms.