# CHEN3600 – Computer-Aided Chemical Engineering Spring 2012

# Chemical Engineering Department Course Project

**T.D. Placek Auburn University**

 **Course Project – Final Report**

During the past weeks, you have received a number of sources of information and data concerning the topic of heatwork. This has included: (1) cone temperature charts (from Orton), (2) output from the cone\_calc program from Orton, (3) web articles concerning the Arrhenius equation, and heatwork theory. In the last report, you developed a technique to calculate the heatwork which is actually accomplished during a kiln firing to a standardized firing based on the cone data provided by Orton.

On the second exam, a problem was presented where cone equivalent temperatures and associated heating rates were tested to see if the heat work performed was consistent. From the exam it was determined that the calculated heat work values were reasonably consistent but far from identical.

The instructor then reported that he was able to used regressed (fit) data for the cone equivalent temperature (CET) vs heating rate to improve the correlation. The data employed by the instructor is provided:

E = 9.4737e+004;

A = 2.0670e+029;

% This is the full Orton data from 10/h to 300/h

tfin=[1179,1195,1205,1212,1217,1221,1225,1228,1231,1233, ...

 1236,1238,1240,1241,1243,1245,1246,1247,1249,1250, ...

 1251,1252,1253,1254,1255,1256,1257,1258,1259,1259];

rate=[10:10:300];

It should be appreciated that the above data is reported (by the cone\_calc program) to a 1 oC value and that heatwork is very sensitive to temperature.

The current project is to use fitted data to calculate the heatwork for all heating rates from 10 to 300 oC/h. This was seen in class to be a smooth function but far from representative of a constant value (as a cone 6 firing requires).

After producing this information, your task is to alter the Arrhenius equation to attempt to make all CET-heating rate data produce the same heatwork. Two approaches are suggested:

1. Improvement might be possible by altering the A and E values given above.
2. Improvement might be possible by altering the form of the Arrhenius equation to modify the pre-exponential factor to be a function of heatwork. The following is suggested as a starting point:

 $k=\frac{A}{f(hr)}e^{-E/T}$

where f(hr) is a simple function of heating rate, such as a low-degree polynomial.

Your final report should tie together your previous interim reports being forward all technical issues involved in firing ceramic materials to cone 6.

The format of this report is to be consistent with the department’s guidelines for technical memorandum (as well as graphs, tables, citations, references, and equations).

Be especially certain that your introduction/purpose clearly expresses the nature of the study being undertaken and that your executive summary and conclusions/recommendations clearly express your finding (as discussed in your results and discussion section). A major component of your course grade is derived from this report.