Memorandum

Date: August 5, 1997

To: Safety & Risk Management Staffs and Selected SuperChems™ Customers
cc: Georges Melhem, Pete Stickles, Sanjeev Mohindra

From: Daniel Nguyen
Loc: 15F/217
Ext: 5482

Subject: SuperChems Flame Jet Model Shows Superior Agreement With Actual Data

On the July 1997 issue of Chemical Engineering Progress (CEP), Robert E. Schwartz and Jeff W. White of John Zink Company published their work of comparison on various methods to predict radiation from flares and estimate flame radiant epicenter locations. Besides discussing the general radiation fundamentals and providing a practical approach to predict radiation, Schwartz and White specifically conducted two examples for comparing several available radiation prediction methods with actual data. Among these methods are: Oenbring & Sifferman (O&S), Tan, API-521-S, API-931, Kent, API-521-B&S, and GPSA. The detailed descriptions for these methods are documented in the July issue of CEP.

This bulletin shows that SuperChems™ prediction of flare radiation fits relatively well with the actual data when comparing with other methods. Example 1 was selected for demonstration. This example is based on an actual flare system located in a gas producing area. The flare stack is equipped with a flare burner that has pilots and flame stabilization devices. The process and physical data required for calculation of radiant heat intensity using SuperChems™ and other methods are listed in Table 1.

Table 1: Process and physical data

Flow rate (kg/hr)	84,360
Gas composition (vol%)	
CH_4	85.0
H_2S	0.1
CO_2	7.0
N_2	7.9
Gas MW (kg/kmol)	18.96
Gas temperature (°C)	50.0
Lower heating value (kcal/kg)	8,600
Outlet diameter (m)	0.610
Wind velocity (m/s)	3.7
Stack height (m)	46

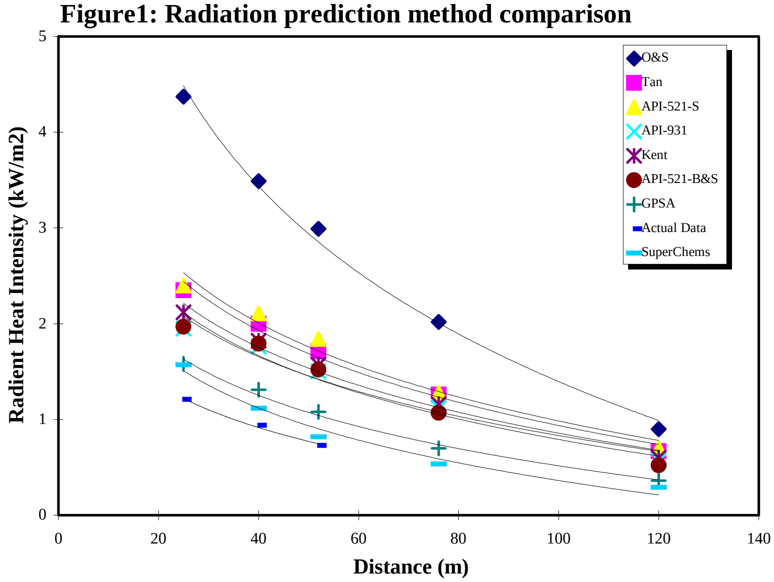
In addition, due to lack of information, the following assumptions were made:

- The given wind speed 3.7 m/s is referenced at the stack height of 46 meters
- Relative humidity of 70%
- Stability class D (neutral)

One should be aware that all the mentioned methods are point-source models while SuperChems™ uses a line-source model for thermal radiation calculations.

Figure 1 compares calculated data from SuperChems™ and other methods with the actual data. Here the radiant heat intensity calculated using SuperChems™ and each complete method is plotted against the distance from the base of the flare stack.

Figure1: Radiation prediction method comparison



As can be seen from the graph, SuperChems™ prediction is closest to the actual test data. SuperChems™ also predicted a radiation fraction of 0.151. The values used for the other methods are shown in Table 2.

Table 2: Comparison of fraction of heat radiated, F

Method	**Fraction of heat radiated, F**
Kent	0.185
Tan	0.209
API-521-S	0.150
API-931	0.170
O&S	0.250
API-521-B&S	0.150
GPSA	0.100
SuperChems™	0.151

Figure 2 shows the jet path calculated by SuperChems™. The indicated dots are the radiant epicenter locations predicted by the corresponding methods relative to the flame observed during the test of the flare. Given the example data, SuperChems™ generates a reasonable flame path, which has its path length of 22 meters.

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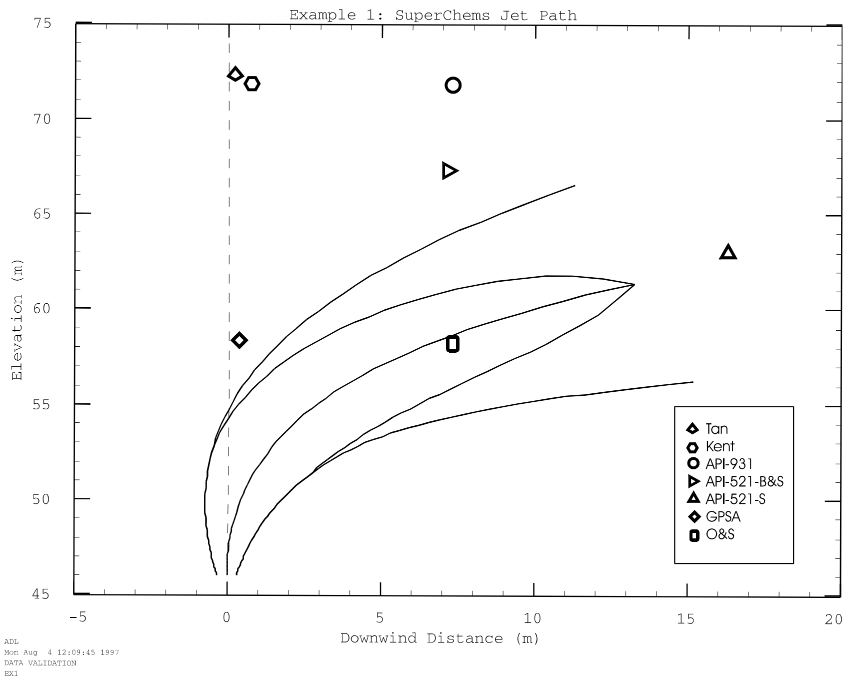

Figure 2: Jet path & comparison of radiant epicenter locations