CENTER for SCIENCE in PUBLIC PARTICIPATION
Kendra Zamzow, PO Box 54, Sutton, Alaska 99674
Phone: (907) 354-3886/ web: www.csp2.org / e-mail: kzamzow@csp2.org
"Technical Support for Grassroots Public Interest Groups"

April 27, 2011

To: Russ Maddoxx
From: Kendra Zamzow
Re: MACTEC memo on Materials Handling (coal dust at Seward) to ADEC

Dear Russ:
I reviewed the June 2010 memo that MACTEC sent to ADEC concluding that operations at the Seward port involving moving 250 tons of coal or less would not exceed ADEC air quality standards.

This kind of review is difficult, as I am not fluent in air modeling and it appears that there are many, many equations that can be applied. Additionally, I was constrained in not having access to the primary reference used by MACTEC, handbooks from the Western Regional Air Project (WRAP). Given those caveats, there are some comments I can make.

Emissions from materials handling
The equation used by MACTEC, and referenced to WRAP is the same that has been used in the AP42 since at least 1988 pertaining to "drop-type operations, per ton of material transferred" (section 11.2, aggregate handling):

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (pound [lb]/ton)}$$

k = particle size multiplier
u = windspeed (mph)
M = moisture content

- The k values used in the AP42 (1988) and by MACTEC are the same for PM10, but MACTEC uses a smaller number (0.0525) than AP42 (0.11) for PM2.5. The effect of this is to presume there are less fine particles.
- The moisture content used by MACTEC is 2.7-7.4% (mean of 4.5%); however, the reason for using that range and mean is not specified. The AP42 uses 0.25-4.8%, but they are using data from Western coal mines; Seward coal could have a higher moisture content.
- MACTEC determined windspeed by using data from 7 sites in the Alaska Climate Research Center database (http://climate.gi.alaska.edu/Climate/Wind/speed.html). While this is a reputable source, the towns with data are not generally representative of Seward, a coastal town with air quality affected by glacial wind-driven dust. Towns such as Whittier, Valdez, and Palmer could be comparable; only Valdez is included in the ACRC database. We do not know if Valdez is one of the towns used, and if it was, the data could be "diluted" by inclusion of data from 6 other sites. MACTEC uses a range of 19-91 mph with a monthly maximum average of 36 mph.

Regarding windspeed, it would be more appropriate to use data gathered at Seward, available at (http://www.wunderground.com/history/airport/PAWD/2009/1/26/MonthlyHistory.html).

The "worst case scenario" developed by MACTEC assumes dry, windy conditions (as suggested by the AP42) and includes 0.7% moisture with wind speeds of 36 mph. However, when data from typical dry, windy months January and February 2008-2011 is reviewed, 3/8 months have maximum average daily wind speeds greater than 36 mph (February 2008, 38 mph; January 2010, 41 mph; January 2011, 39 mph). Additionally, in some months it appears that there were sustained wind gusts in the 40-50+ mph range for several days in a row (e.g. January 2009, January 2010, February 2011) under dry conditions (see attached Excel document).

How do these assumptions change the presumed lbs of particulates per ton of handled material?
MACTEC calculations result in

PM10 = 0.06 lbs/ton material
PM2.5 = 0.0095 lbs/ton material

If assumptions of k=0.35 is used for PM10 (same as MACTEC) and k=0.11 for PM2.5, changing wind speed to 41 mph, and changing moisture content to 0.25%,

PM10 = 0.32 lbs/ton material
PM2.5 = 0.10 lbs/ton material

Although the changes in moisture and wind speed are small, the effect is that the worst case scenario as calculated by MACTEC may underestimate the particles released per ton of coal handled by at least an order of magnitude, and potentially by two orders of magnitude for fine particles. I was unable to follow this through to determine the potential impact on the ADEC standards for ug/m^3.

Wind Erosion of Stockpile

When considering wind erosion, it appears that both MACTEC and AP42 consider the amount of time that the wind is above the minimum speed needed to pick up particles (around 12 mph at the surface of the coal), but do not consider the actual wind speed above that – that is, whether the wind is 15 mph or 50 mph is not important.

My calculations in 2009

Two years ago, I estimated that potentially up to 510 tons of coal dust could be blown off the stockpiles at Seward each year. Despite efforts to contact ADEC and others, I was unable to get my calculations independently verified. My calculations determined tons/month using the equation:

Equation: EF * acres * 720 hrs/mo * ton/2000 lb

The assumptions included

- the number of acres covered by the coal piles (34 acres),
- conversion factors (for hours/mo and lbs/ton)
- actual wind speeds (not just frequency of time over 12 mph)
- the emission factor:
  Emission Factors = 1.6 * windspeed (in m/s) = lb/(acre)(hr)

MACTEC calculations

MACTEC uses an entirely different equation to achieve lbs/acre/day using the equation:

E (TSP) = 1.7 * (s/1.5) * (f/15) as lbs/acre/day

They consider

- % silt (particles < 75 um)
- % time at which the windspeed is >12 mph (the speed assumed to be needed to lift particles)

Additionally, they use k figures of k= 0.5 for PM10 and k= 0.075 for PM2.5. It appears that this is related to emission factors for "total suspended particles" (TSP). I am unclear why they use different k factors in this equation than in the previous one. Additionally, I am unclear how they use these k factors to change the "1.7" in the equation to

E (PM10) = 0.85 * (s/1.5) * (f/15) as lbs/acre/day

E (PM2.5) = 0.13 * (s/1.5) * (f/15) as lbs/acre/day

For a "worst-case scenario", it is assumed the wind is always greater than the 12 mph needed to move particles, but it is unclear why MACTEC used a "worst-case scenario" of 3.9% silt:

a) the actual silt content of Usibelli coal should be easy to obtain from Usibelli

b) it is unclear why an equation using a silt percentage is needed when calculating emission factors for PM10 and PM2.5 material

Lastly, they used a figure of 200,000 tons of processed material per acre of stored material based on "generalized sites in Alaska". I am unclear where this fits into the equation, however, it seems it would be quite easy to get real figures from Usibelli regarding the acres required for storage and the tons of material processed at the Seward facility each year.

AP42 calculations

This can be compared to the equation used by the AP42:

$$\text{Emission factor} = k \sum_{i=1}^{N} P_i$$

This equation is focused on wind erosion, rather than "drop-type" materials handling, and includes the "erosion potential" (P) and the number of times the pile is handled (N); it also uses different k numbers (k = 0.5 for PM10, k = 0.075 for PM2.5). The "P" actually involves more equations related to wind speed, and how often wind is high enough to lift particles.

It is very difficult to make comparisons between the methods. While both consider the amount of time the wind is high enough to lift particles, the MACTEC method does not consider how often the pile is "disturbed". Additionally, it isn't clear why % silt is important (particles of size 0.75 um or less) when calculations are developed based on particles <10 um (PM10) or < 2.5 um (PM2.5). I was unable to find the equation used by MACTEC in any of the AP42's (1988, 1998, Western Coal Mining section, Aggregate Handling section). If the equation is provided in the WRAP handbook, it might be useful to order the handbook and review it.

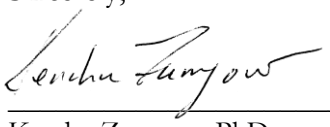
ADEC air standards

The MACTEC materials handling and wind erosion numbers were fed into a model to determine the particles in grams per cubic meter of air. I do not have the expertise to use the model or evaluate how valid the inputs are, except for the evaluation of parameter inputs described above.

Summary and Recommendations

In summary, it is possible that the "drop" material handling equation underestimates the particles that could enter air, particularly in worst-case scenarios. It is very difficult to analyze the "wind erosion" of the stored coal. In addition to the factors mentioned above, such as whether the % silt should be included, the compaction of coal, shape of coal pile, moisture (rain and snow) percolating into the coal, and how "crusted" the coal is all affect the particles leaving the coal furrows. However, calculations could likely be improved by relying on actual data from Seward, such as wind speeds, and data from Usibelli and/or the Alaska Railroad (silt content, tons of material handled, acres required for storage). It would also be useful to determine the prevailing wind direction during the dry, windy months of winter, and whether that has a potentially higher or lower impact on residents, the harbor, or other facilities.

Sincerely,



Kendra Zamzow, PhD