Comparison of SF/Profume Fumigation Treatment in US Mill vs. (indirect) Steam/Air Heat Treatment

James R Smith – **Armstrong** Heat Transfer Group May 13, 2009

(for KSU-Manhattan, Ks. Grain Science Workshop)

Synopsis:

Concerns about CO2e, GWP and other currently popular determinants for environmental evaluations of MeBr alternatives requires some analysis of recently presented data and available factors from US governmental and internationally recognized sources.

The following involves a simplistic comparison of two (2) alternatives: Sulfuryl-Fluoride (SF)/"Profume" a registered fumigant alternative to MeBr, and Steam to Air (Indirect) heating (Thermal Remediation/Heat Treatment) for structural, post-harvest applications.

This brief analysis is being presented to solicit comments, confirm calculations, paybacks or technical accuracy for general review and feedback at the KSU-Workshop 2009. ***The purpose is not to promote efficacy differences of the fumigant (SF/Profume) vs. Heat Treatment alternatives*** (existing plant steam based energy sourcing).

The intention is to assist the reader to evaluate CO2e and GWP issues presently under consideration during transitional decision making at mills and other facilities as MeBr, CUE, and availability for structural heat treatment continues to diminish sharply.

The summary results, if verifiable, may assist a plant/mill executives when considering one of these alternatives. It may be a simple tool for both cost and environmental decision making.

Armstrong Heat Transfer Group, James R. Smith, CEM, Product Mgr. – Power/Utility/Process
PH: 450-378-2655 ext 324 CELL: 330-256-7790 e-Mail: jrsmith@armstronginternational.com

General Discussion:

Mr. Bob Williams (Dow Agro Sciences), made an outstanding presentation during the Kansas State (Manhattan, Ks) Dept. of Grain Sciences 2009 Heat Treatment Workshop, detailing the use of SF/Profume in a typical mill along with Global Warming Potential (GWP) and Carbon CO2e footprints of this fumigant alternative to MeBr.

Booster/Heat Support for SF/Profume:
From Mr. Williams's comments, there is some gain in cost and use efficiency (**not efficacy**) and thus, potentially, less lbs of the fumigant, if temperatures are raised to a MINIMUM of 85dgF (or higher - probably up to 100dgF). If STEAM HEATING (from available plant/mill existing boiler generated system) was utilized for a "ramp up" of temperature from normal in-plant ambient (e.g. 65-70dgF), there may be a mutually beneficial involvement of both HEAT and Fumigant for improved results/costs in plants that want to stay with the Fumigant alternatives to MeBr. Thus the use of additional or "booster" heat sourcing may have some positive value for end user mills/plants. This can be facilitated by minor increased heating surface modifications to existing plant heating systems and/or use of temporary/portable heat source alternatives. One of these options would be steam, primarily if the plant already has a central system for process or general plant HVAC requirements.

Evaluating the Steam Alternative (no registration needed):
It is of some interest to take this to the next step of consideration.

While considering the use of HEAT, and utilizing steam generated in a typical (Natural) gas fired, fire-tube boiler (common), with a minimal 80% efficiency (relatively low these days, but conservative), one can readily develop comparative cost-per-fumigation with cost-per-heat treatment (steam sourced) for analysis.

Additionally, the CO2e (emissions) values and thus Global Warming Potentials (GWP's) can be determined using readily available tables, conversion charts and other resources (e.g. US EPA, EIA, DOE, etc..).

The slides presented by Mr. James Bair are summarized below relative to utilization of SF/Profume in a North American (US) Mill fumigation:

Green House Gas Emissions - What if all US Mills were fumigated with SF (Profume)?

Example 1)
Avg. Mill - 1.0 Million cu.ft.
SF/PROFUME Dosage - 3.0 lbs/1000 cu.ft.
GWP of SF/Profume - 4,800** lbs CO2-equivalent (CO2e) Avg. FUMIGATION - 14.4 million lbs. of CO2e Annual Estimated Mill Fumigations - 400 fumigations/yr = 5.8 billion lbs CO2e (US mills) Or 2.6 Million Metric Tons of CO2e Carbon Footprint of 1 (one) Car (US EPA) - 12,100 CO2/yr Result - if TOTAL US Milling Industry was to use SF/Profume, per above, would be equivalent to adding 476,033 cars/yr.
(** Ref NOAA – 2008 data +/- 30% (100 yr Time Horizon)

Example 2)
Mill - Size - 2.0 million cu ft
SF/Profume Dosage / Fumigation and CO2e - GWP
SF/Profume Dosage - 3.0 lbs./cu ft with
GWP of SF/Profume - 4,800 lbs CO2e
1 Fumigation per year- 28.8 million lbs CO2e or
13,061 MT (Metric Tonnes) CO2e
2 Fumigations per year - 57.6 million lbs CO2e or 26,122 MT CO2e

Changing to STEAM as the Alternative:
BASIS FOR Steam Sourced (indirect Steam/Air) Heat Treatment:
1 (one) Heat Treat lasting 2 day (48 hour continuous) using a 100 PSIG steam source from a Gas Fired (Nat.Gas) boiler at 80% efficiency.
Steam Generation/Production/Distribution cost basis to be used is $9.00/1000lbs utilized (within N.Am. industry guidelines) (will vary with fuel costs)
The above is a very reasonable estimate of costs and efficiencies for a typical industrial steam plant.

Armstrong Heat Transfer Group, James R. Smith, CEM, Product Mgr. – Power/Utility/Process
PH: 450-378-2655 ext 324 CELL: 330-256-7790 e-Mail: jrsmith@armstronginternational.com

STEAM COST CALCULATIONS:
Using Example 2) from Mr. Bair, above, for a 2.0 Million cu ft Mill and using a VERY HIGH estimate of 10 BTUH/cu ft, results in a simplified Energy Demand profile for heat treat of 2,000,000 x 10 = 20,000,000 btuh.
20,000,000 Btuh x 48 hours (assumed) = 960,000,000 btu (Q total steam energy consumption)
Using 880 btu/lb (100 PSIG Sat. Steam, Latent Heat of Vaporization) steam = 1,090,909 lbs of steam usage in 48 hours heat treat.
$ 9.00/1000 lbs. of steam used = ***$ 9818.18 Steam Cost Total (48 hours)***

FUEL CONSUMPTION: (NG Basis)(Steam Heat Treatment)
Using data of 1.25 MM BTU fuel/ 1000 lb of steam generated -
(1,090,909 lbs generated / 1000) x 1,250,000 Btu Fuel (Nat gas) =
1,363,636,250 BTU Nat Gas Consumed

GWP (CO2e): (NG Basis)(*Steam* Heat Treatment)
1,363,636,250 BTU (NG) / 1,000,000 = 1,363.64 x 0.05322 =
72.573 Metric Tonnes CO2e per Heat Treatment.
72.573 Metric Tonnes CO2e x 2,204.6 = 159,994.44 lbs of CO2e
(Compare with 1 Fumigation at 28,800,000 lbs of CO2e or 13,061 MT (Metric Tonnes) CO2e)

The above, though preliminary, is quite significant if verifiable.

HOWEVER, if the above comparative analysis is (even) of moderate accuracy, it clearly shows a potentially SIGNIFICANT BENEFIT to the utilization of (indirect) Steam/Air Heat Treatment from an environmental and also cost standpoint. This extremely well proven yet, quite mundane, heat treatment alternative does not require any special registration.

Evaluation of this option is currently available to many mills/plants and should be taken into consideration as an alternative to MeBr as part of total IPM implementation.

Obviously the initial infrastructure cost (steam/condensate piping, etc.) if not already in place may be amortized over an extended plant life period (e.g.20 yrs). The actual operational cost per Heat Treatment, and utilized by many mills across N. America (and now in Europe) is obviously extremely low.

Resultant PER HEAT TREATMENT COST of the example case (typical) at $10,000/2 day (48 full hours) utilizing steam is quite a viable alternative.

This review does not include a value (per lb. cost) of the SF/Profume fumigant, as this is available from any current source of supply (Dow Agro-Science associated).

Compare total pounds of SF/Profume per single (1) Fumigation for the 2 Million Cu.Ft. Mill example for a 2 (two) day Fumigation cycle (direct comparison) vs. the $10k steam cost value calculated above. This simple comparison allows for easy alternative evaluation.

Note that the steam/energy inputs provided by Armstrong (used above) are highly qualified, based on long standing energy combustion
(Ref: 2005, the UN FCCC approved an Armstrong methodology for steam savings and CO2 emissions reduction. This methodology is based on a project design document "Steam system efficiency improvements in refineries in Fushun, China".)
(ref:
http://cdm.unfccc.int/UserManagement/FileStorage/AM0017_version_2.pdf)
(CDM **Clean Development Mechanism** / UNFCCC. **United Nations Framework Convention on Climate Change)**

Editorial input: Michelle Marcotte, Marcotte Consulting
marcotteconsulting@comcast.net

SF/Profume clarification: Bob Williams, Dow Agro Science

rewilliams@dow.com