METAM SODIUM SEALING METHODS TO INCREASE DOSE OF BIOCIDE AND IMPROVE EFFICACY

David A. Sullivan, Executive Director
Metam-Sodium Task Force

Metam sodium is an effective biocide for the control of weeds, soil-borne diseases, and nematodes when there is sufficient contact with the target organisms. Contact, described as the product of concentration and time, within certain limits, is the critical factor to promote the effective use of fumigants such as metam sodium.[1] Although the only registered methyl bromide replacement with such broad target coverage, there are two essential requirements to successfully use metam sodium as a methyl bromide alternative. The first is to recognize that application methods need to compensate for the more limited diffusion of the biocide in the soil relative to methyl bromide. The other is to use sealing methods that are effective in minimizing volatilization loss of methyl isothiocyanate (MITC), the breakdown product that is the key biocide. With these two factors in mind, the Metam Sodium Task Force (MSTF) has taken major steps this past year in both areas to further strengthen metam sodium for its transition from a methyl bromide competitor to a methyl bromide replacement.. This paper focuses on enhanced volatilization control, as a key step towards improving efficacy and expanding the efficient use of this product.

Enhanced control of MITC volatilization rates promotes two positive results: (1) the concentrations of MITC within the soil and the dose of MITC exposures to target pests can be increased to help improve the quality and consistency of product efficacy, and (2) environmental management is improved, including more effective and consistent control of odors. The following provides a brief summary of laboratory and field studies conducted by the MSTF over the past year aimed at minimizing volatilization losses:

Bench-Scale Sealing Study 1999 – Trials were conducted in the laboratory on alternative sealing methods, simulating applications by both chemigation and shank injection. Sealing effectiveness was evaluated over a four-day period comparing a standard one-half inch water seal applied immediately after application with compaction, VIF tarp, foam, and intermittent water seals.[2] The intermittent water sealing method for shank injection was found to be essentially comparable to the use of VIF tarp and superior to the other methods tested.[3] The results for chemigation were not as conclusive, but suggested some potential benefit to the use of intermittent sealing.

---

[1] E. Van Wambeke, "Soil Mulching for Chemical Soil Disinfestation, Possibilities and Evolutions," Acta Horticulturae, 255, 1989.

[2] In this context, an intermittent seal refers to creating a water seal based on multiple passes of the field, rather than applying the water in one continuous period.

[3] Merricks, D. Larry, "Laboratory Methods of Sealing Soil Surfaces to Reduce Off-Site MITC Concentrations Following Treatment with Metam Sodium by Injection and/or Sprinkler Application," Sponsored by the Metam sodium Task Force, May 2000.

Field Studies - During the period of June 1999 through June 2000, the MSTF conducted six field studies aimed at identifying baseline off-gassing levels and evaluating alternative methods to seal fields. The studies are summarized in Table 1.

Summary of Key Observations

- Intermittent water sealing for shank injection the most effective method in laboratory testing, and subsequent field trials conducted in Santa Barbara County and Lost Hills, California showed excellent retention of the MITC within the soil, based on emission rates computed from measured air quality data and dispersion modeling. Based on study to date, approximately a five-fold reduction in MITC loss by volatilization over comparable four-day periods after application was found when using intermittent sealing during the first two evenings after application (as evaluated in Lost Hills in June 2000) compared to sealing with one-half inch of water for one day during mid afternoon at the completion of the sets (as evaluated in Bakersfield in June 1999). Another way to consider the differences in retained biocide, is to compare 65 gallons/ acre retained for Lost Hills, with 25 gallons/acre retained using standard methods as represented by the Bakersfield shank injection study of 1999. It should be noted that Lost Hills had comparable soil porosity as in Bakersfield and low (0.8%) organic content.

- Foam was not found to be effective in improving biocide retention.

- VIF tarp was found to be effective for enhancing biocide retention based on laboratory testing, but not superior to the use of the intermittent sealing method.

- Offsite concentrations of MITC measured in Lost Hills in June 2000, based on the new MSTF recommendations for injection rig specifications and intermittent sealing procedures for sensitive areas, were on the order of 4-5 times lower than the comparable application that was monitored in Bakersfield during June 1999.

- While daytime volatilization rates at Lost Hills were found to be comparable to those in Bakersfield, nighttime volatilization rates were effectively eliminated all four nights in Lost Hills using the intermittent sealing method. In the field studies conducted with standard sealing methods, nighttime periods produced the highest greatest loss of product through volatilization and highest air quality impacts.

- Model-based emission rates estimates based on the EPA dispersion model, ISCST3, and measured airborne concentrations of MITC from a 15-station monitoring network at Lost Hills, showed substantially lower computed emission rates than observed in Bakersfield using standard application / sealing methods.

- Similar research can be done to refine sealing methods to meet the needs of alternative climatic conditions, soil conditions, and cultural practices.

Table 1

Air Quality Field Studies Conducted by the Metam-Sodium Task Force During the Period of June 1999 through July 2000

Study Location	Month/Year	Application Method	Number of Monitoring Sites	Intermittent Seal?	Personal Exposures	Acres Applied
Bakersfield, CA[4]	June 1999	Chemigation	10	No	Yes	80
Bakersfield, CA[3]	June 1999	Shank	10	No	Yes	79
Lancaster, CA[5]	March 2000	Chemigation	8	Yes	No	34
Santa Barbara Co., CA[6]	May 2000	Shank	8	Yes	No	22
Lost Hills, CA[7]	June 2000	Shank	15	Yes[8]	Yes	40
Tennessee	March 2000	Incorp. / Tarp	4	No	No	5

[4] Merricks, D. Larry, "Determination of Methyl Isothiocyanate Offsite Air Movement from the Application of Metam Sodium through Shank Injection and Sprinkler Irrigation," Sponsored by the Metam sodium Task Force, November 1999.

[5] Sullivan, David A., "Pilot Field Study of a Sprinkler Application Using Intermittent Water Sealing Methods: Lancaster, California," Sponsored by the Metam sodium Task Force, March 2000.

[6] Sullivan, David A., "Pilot Field Study of a Shank Injection Application Using Intermittent Water Sealing Methods: Santa Barbara County, California," Sponsored by the Metam sodium Task Force, May 2000.

[7] (*Report in progress*).

[8] Intermittent seal refers in this context refers to the following procedure. The field was sealed upon completion of each set with a ½ inch of water. The field was then sealed on an intermittent basis in the evening of the day of application with a total of ½ inch of water applied in two ¼ inch passes during the period of approximately 4:00 P.M. through midnight. Intermittent sealing was then repeated approximately 4:00 P.M. to midnight of the second day. The intermittent sealing used for the Lancaster and Santa Barbara County studies, on the other hand, was based on the intermittent seals being applied at approximately sunset, 10:00 P.M. and 2:00 P.M., with comparable water quantities applied.