The pH Factor

by Paul Sartoretto, Ph.D.

Almost everyone knows that water with a pH reading of 7 is neutral, neither alkaline or acid. Perhaps, not as well known is the fact that pH numerical readings are expressed on a logarithmic scale. In other words a pH of 8 is ten times more alkaline than a pH of 7, and a pH of 9 is one-hundred times more alkaline than a pH of 7. Likewise, a pH of 6 is ten times more acid than 7, and a pH of 5 is one-hundred times more acid, and a pH of 4 is one thousand times more acid than a pH of 7.

The pH of water that is available to the golf course superintendent is something over which he has no control. He can be blessed with a source that runs 6.5 to 7, or he can be cursed with water that runs as high as 8, 9, or even 10. Constant irrigation of a golf course with highly alkaline waters is a serious problem which can only be corrected safely by repeated applications of elemental sulfur which slowly and safely oxidizes to sulfur dioxide and sulfur trioxide neutralizing the alkalinity.

However, this discourse is confined to the effect of pH of water on various pesticides in the spray tank and the measures one can take to partially compensate for some of the deleterious effects of alkaline waters.

In general the loss in effectiveness is due to hydrolysis; and rate of hydrolysis is determined by (1) pH, (2) the chemistry of the pesticide, (3) time of exposure in the spray tank, (4) temperature of the water in the spray tank.

(1) As stated before, pH is measured in logarithmic units and the hydrolysis rate of an alkaline sensitive chemical will increase by a factor of ten for every pH unit.

(2) The chemistry of the pesticide is an extremely important factor. Most chemicals will undergo alkaline hydrolysis. On the other hand, some are acid sensitive and will undergo acid hydrolysis.

(3) Time of exposure in an alkaline medium is also a critical factor. What comes out of the spray tank during the first hour of spraying could be more effective than what comes out during the last hour of spraying.

(4) An increase in temperature of 10°C (18°F) will double the speed of decomposition. The sun ray's beating down on a spray tank will have some effect on the rate of hydrolysis, and so will constant agitation tend to warm up the spray mixture.

Various pesticide manufacturers have supplied date showing the effect of pH on the half life of their pesticides and is being reported here in table form.

Surprisingly, the insecticides Dursban and Diazinon, although affected adversely by pH, still have extremely long half-lives at high pH's. This is not consistant with what the golf course superintendent is finding in the field. Perhaps resistant strains of insects play a more important part than pH.

On the other hand products like Sevin, Malathion, Dylox (Proxol), and actidione are severely affected by high pH's. Adjusting the pH of the water in the spray tank would most assuredly improve their effectiveness.

Aside from pesticides, there are tremendous amounts of iron, magnesium, and other trace elements being used as adjuvants in spray mixtures. With the exception of boron, which is not

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truly metallic, all of the metallic salts will undergo hydrolysis at pH above 7 and end up as hydroxides and oxides which are totally inactive. The classic example is ferrous sulfate which hydrolyzes rapidly and will end up as inactive iron oxide rust, sometimes in sufficient amount to clog the sprayers.

When these metals are chelated they become immune to hydrolysis and are totally and completely available to the plant.

Correcting the pH of the water in the spray tank is possible and achievable, but should not be done haphazardly. The accurate way to monitor pH is with a pH meter. But these meters can go haywire unless they are checked and standardized on a daily basis. The use of pH paper is a cruder way of checking pH and will not be accurate within 0.5. But since a pH of between 6.5 to 7 is an acceptable range, one can get by with pH paper.

The one acid that is readily available to everyone is vinegar. It should be carefully added to the water in the spray tank in small increments, checking with pH paper. If too much vinegar is added and the pH drops below 6.5, the pH can be brought back with household ammonia. Always adjust the pH of the water before adding the chemicals to the spray tank.

W. A. Cleary Chemical Company has developed a very safe acidifier which also acts as a chelating agent. Although, slightly more expensive, it comes with a supply of pH paper and instructions for use. I don't know of any other chemical company that has a comparable product.

There is an important caution that the superintendent must be made aware of — the effect of pH on postemergent herbicides. Specifically, herbicides such as 2, 4-D, MCPP, MCPA, and Dicamba are water insoluble acids that have been put into solution with amines. These solutions are always alkaline, and if they are acidified these herbicides drop out as water insoluble gums, which will foul up the spray tanks. They are best sprayed with the alkaline water. **Never adjust the pH of herbicidal sprays.** However, methylarsonates such as MSMA and DSMA are unaffected by pH.

The best way to conclude this article is to remind the superintendent that unless he carefully and painstakenly adjusts the pH of his water within the narrow limit of between 6.5 to 7, it would be better for him to accept the alkalinity of his water and do nothing at all.

Common Name	Chemical Name	pH	Half Life Time
Dylox	Trichlorophon	6	89 hr.
Proxol		7	6.5 hr.
		8	63 min.
Malathion	Malathion	◄5	1 hr.
		7	7.8 hr.
		►8	1 hr.
Sevin	Carbaryl	6	100-150 days
		7	24-30 days
		8	2-3 days
		9	3 hr.
		10	20 min.
Betasan	Bensulide	4 (20°)	28+ days
		7	27+ hrs.
		10	21+ hrs.
Diazinon		3	706 min.
		5	31 days