LIQUIDOW™ versus Other Brines for Dust Control

Introduction

The dust control effectiveness of a brine application on an unpaved road is largely dependent on the hygroscopic nature of the brine. The more hygroscopic the brine, the better the dust control because the road remains moist even under demanding summer conditions.

Two properties determine the hygroscopic nature of a brine – the composition and the concentration of the dissolved salts. Composition is important because some salts are highly hygroscopic, ($CaCl_2$, $MgCl_2$), and some are not, (NaCl, KCl). Concentration is important because the more concentrated the brine, the lower the transportation and application costs per mile of treated road. Let's look at some real world data to see how brine quality affects performance and cost.

Field study: LIQUIDOW™ vs. Oil Field Brine

In late summer of 1981, a seven-week dust control study was conducted on a 3/4 mile section of Schreiber Road in Midland Co., Michigan, comparing the effectiveness of 38% LIQUIDOW™ to Porter Oil Field brine. Liquid application rates were based on applying equal amounts of dry solids. Dust was collected with high volume air samplers and filters mounted on the edge of the road. During sampling, traffic was controlled at 45 mph, with an equal number of vehicle passes by each collection site. The study found that the 38% LIQUIDOW™ controlled dust 3X better than the Porter Oil Field brine, (see Table 1). Note that the 3X improvement in dust control effectiveness correlates well with 3X more hygroscopic salt in 38% LIQUIDOW™ on a solution basis.

Table 1. Schreiber Road Study, Midland Co., MI

	LIQUIDOW™ 38% $CaCl_2$	Porter Oil Field Brine
% $CaCl_2$	38%	9%
% $MgCl_2$	< 1%	3%
% NaCl	< 1%	15%
Application Rate	0.33 gal/yd^2	0.44 gal/yd^2
Avg. Dust Emission	0.15 mg/m^3	0.45 mg/m^3

Lab study: Ludington $CaCl_2$ vs. Dundee Brine

In 1949, the hygroscopic nature of Dundee brine, (similar to the Porter Oil Field brine), was compared to that of Ludington calcium chloride. Calculations show that Ludington 38% calcium chloride would contain approximately 3X more hygroscopic salt than Dundee brine on a solution basis, and at 90 °F and 67% relative humidity, would form approximately 3X more solution by volume at equilibrium.

These two studies strongly support the position that hygroscopic salt content is of primary importance in achieving good dust control with a brine.

Table 2. Hygroscopic Properties at 90 °F and 67% RH

	Ludington 38% $CaCl_2$	Dundee Brine
% $CaCl_2$	38%	9%
% $MgCl_2$	< 1%	2.5%
% NaCl	< 1%	13%
Solution formed	30.5 ft^3/ton shipped	10.9 ft^3/ton shipped

Economics always favor well-head brines… right?

Wrong. It's fairly easy to get fooled. The tendency is to judge total cost strictly on the basis of product cost. However, other important factors cannot be overlooked or minimized, such as transportation and application costs, along with performance and productivity. Back in 1977, experience gained in Wayne Co., Michigan was used to develop a cost comparison between a good quality well-head brine, (approx. 25.5% hygroscopic salt) and 38% LIQUIDOW™. The basis for the comparison was spreading an equal amount of hygroscopic salt per mile using a 3700 gallon truck making three trips per day. As Table 3 shows, a relative small premium in total cost for 38% LIQUIDOW™ buys a large productivity premium.

Table 3. Dust Control Cost per Mile, Wayne Co., MI

	Ludington 38% $CaCl_2$	Well Head Brine
Application Rate	3320 gal/mile	5360 gal/mile
Miles/day	3.34	2.07
Product Cost	371% more	---
Freight Cost	---	49% more
Spreading Cost	---	61% more
Total Cost	6% more	---
Productivity	61% more	---

Freight and spreading costs combine to make low concentration brines economically attractive only in the immediate vicinity of their source. In every instance, equipment usage will be less and job completion faster when 38% LIQUIDOW™ is used for dust control.

The studies cited in this analysis are relatively old, however time does not lessen their value. The properties that determine the dust control effectiveness of brine-based products are the same today as they were 50 years ago. Time is not a factor.

LIQUIDOW™ versus Other Brines for Dust Control

LIQUIDOW vs. SOLNAT Brine for Dust Control

The case studies presented on the previous page clearly demonstrate that dust control effectiveness of salt-based solutions depends on the quantity of hygroscopic salt in the product. This knowledge can be used to predict the performance of two products competing in today's dust control market, 35% LIQUIDOW™ and SOLNAT brine.

Table 4 compares the compositions of these two products. Based on total hygroscopic salt content, the SOLNAT brine is similar in composition to the Porter and Dundee brines shown on the previous page in Tables 1 and 2.

Table 4. Composition of LIQUIDOW™ versus SOLNAT

	LIQUIDOW™ 38% $CaCl_2$	SOLNAT Brine
Wt % $CaCl_2$	35%	13%
Wt % $MgCl_2$	Negligible	<1%
Wt % NaCl	0.6%	7%

Since dust control performance is primarily dependent on hygroscopic salt content, it is logical to expect that the performance differential between 35% LIQUIDOW™ and SOLNAT brine would similar to that found between 38% LIQUIDOW™ and the Porter and Dundee brines. In other words, 35% LIQUIDOW™ would be expected to significantly out-perform SOLNAT brine.

Can the performance deficiency of SOLNAT brine be offset with higher application rates?

SOLNAT brine is marketed on the basis that it requires 30 to 50% more product by volume to achieve equivalent performance to 35% LIQUIDOW™. Table 5 shows how this increased application rate affects the relative amount of hygroscopic salt that gets applied to the road.

Table 5. Influence of Product Application Rate on Hygroscopic Salt Application

	LIQUIDOW™ 38% $CaCl_2$	SOLNAT Brine
Volume Basis	1 liter	1.5 liters
Weight	1.353 kg	1.166 kg
Hygroscopic Salt	0.474 kg	0.227 kg

Even at 50% greater volume, SOLNAT brine still contains less than half the amount of hygroscopic salt compared to 35% LIQUIDOW™.

There are two other issues associated with high application rates. The first is productivity. Refer back to Table 3 for an excellent example of how application rate negatively affects productivity. High application rate requires more truck re-fills to treat a certain amount of road. The more return trips for filling, the fewer miles treated per day. Fuel, labor and depreciation costs also increase when application rate increases.

The second issue associated with high application rate is increased risk of run-off. Some road materials are more absorbent than others. As application rate increases, so does the risk of brine running off the road into the ditch before it can soak into the road. Not only is this a waste of product, but it also can lead to negative environmental impact. More on that in the following section.

What role does the NaCl in SOLNAT brine play?

Not a good one. Approximately 30% of the salt in SOLNAT brine is NaCl. Since NaCl is a solid under most summer conditions, it provides little to no dust control benefit. Worse yet, the sodium in NaCl is detrimental to soil structure and soil permeability. Environment Canada has declared chloride-containing deicing salts to be CEPA toxic, requiring the development of best management practices to minimize introduction to the environment. While dust control products do not currently fall under this CEPA program, the introduction of a NaCl into the environment without gaining any benefit is obviously contrary to good environmental stewardship.

Table 6. NaCl Introduced into the Environment

	LIQUIDOW™ 38% $CaCl_2$	SOLNAT Brine
Application Rate*	7,300 liters/km	10,950 liters/km
NaCl	59 kg/km	894 kg/km

*lane width of 5.5 meters, SOLNAT rate = 1.5X LIQUIDOW™ rate

Originally Published June 2005
Form 173-01711-0909

Occidental Chemical Corporation
A subsidiary of Occidental Petroleum Corporation

5005 LBJ Freeway, Suite 2200
Dallas, Texas 75244-6119
888-293-2336