



CHEMIR

Analytical Services

12, February 2007 (REVISED: 19, February 2007)

Bio-dex Laboratories
501 W. Lone Cactus Drive
Phoenix, AZ 85027

Re: NMR Quantitation
P.O. #: 4281
Chemir Analytical Job #: 62214

We have completed the analysis of the submitted sample by ^{31}P Nuclear Magnetic Resonance Spectrometry (NMR). The results are summarized below.

SAMPLE LOG-IN

The sample was logged as follows:

SAMPLE DESCRIPTION	CHEMIR ANALYTICAL SAMPLE NUMBER
Salt Protect	563218

ANALYSIS CONCLUSIONS

The total phosphorus content was quantitated by ^{31}P NMR, utilizing phosphoric acid as an internal standard and collecting data in D_2O . The phosphorus content of the sample "Salt Protect" (Chemir #563218) was found to be 36.5 ppm. Dilution of 1 quart of the sample into a 10,000 gallon pool would result in only trace levels of phosphorus.

ANALYSIS RESULTS/DISCUSSION

A phosphoric acid stock solution was prepared by dissolving 85% phosphoric acid in deuterated water (D_2O) according to the table below. An intermediate stock solution was prepared by dilution of the stock solution in D_2O also according to the table below.

SOLUTION	SOURCE	Wt. SOURCE (g)	FINAL Wt. (g) + D_2O	CONC. P (ppm)
STOCK	85% H_3PO_4	0.1247	10.0052	10,593.99
Int. STOCK	STOCK	0.2401	5.0102	507.69

A sample was prepared by adding 0.1200 g of the sample "Salt Protect" (Chemir #563218) to a 5 mm NMR tube, followed by 0.2504 g of the intermediate stock solution prepared above. Sufficient D_2O was then added to bring the final mass to 0.5140 g, resulting in a P concentration of 247.34 ppm. The sample was then analyzed by collecting a ^{31}P NMR spectrum and integrating the respective phosphoric acid and unknown phosphorus peaks as observed in the spectrum.

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³¹P{¹H} NMR Analysis

Nuclear Magnetic Resonance Spectrometry (NMR) is an extremely useful method for material characterization. NMR is a physical phenomenon based upon the magnetic property of an atom's nucleus. NMR studies a magnetic nucleus (most commonly that of a hydrogen atom), by aligning it with a very powerful external magnetic field and perturbing this alignment using an electromagnetic pulse. The response to the perturbation is recorded, with each individual nucleus giving a response specific to its chemical, electronic, and spatial environment.

The resulting ³¹P NMR spectrum can be found in CHART 1. The integrals corresponding to the phosphoric acid and unknown phosphorus peak correspond to 96.674 and 3.326, respectively. The following calculations were used to determine the levels of phosphorus in the sample "Salt Protect" (Chemir #563218).

$$\frac{\text{Area}_{\text{P-std}}}{\text{Area}_{\text{P-sample}}} = \frac{\text{Conc}_{\text{P-std}}}{\text{Conc}_{\text{P-sample}}}$$

$$\frac{96.674}{3.326} = \frac{247.34 \text{ ppm}}{x}$$

$$x = 8.51 \text{ ppm}$$

This corresponds to the concentration of phosphorus in the sample as prepared. In order to calculate the concentration of phosphorus in the original sample, the dilution factors must be accounted for. Because 0.1200 g of the sample "Salt Protect" (Chemir #563218) was diluted to a final mass of 0.5140 g, the original concentration of phosphorus in the sample "Salt Protect" (Chemir #563218) can be calculated according to the following equation, where x represents the concentration of phosphorus in the sample "Salt Protect" (Chemir #563218):

$$(8.51 \text{ ppm})(0.5140 \text{ g}) = (0.1200 \text{ g})x$$

$$x = 36.5 \text{ ppm}$$

INSTRUMENTATION

SCIENTIFIC INSTRUMENT	MANUFACTURER/MODEL	PURPOSE
Bruker Avance 300 NMR	Bruker	Identify Materials - Structural and Conformational Determination

CHARTS

Enclosed please find the following CHART generated during the analysis.

ENCLOSURE

DESCRIPTION

CHART 1 ³¹P{¹H} Nuclear Magnetic Resonance (NMR) spectrum obtained for the sample "Salt Protect" (Chemir #563218), including a phosphoric acid internal reference standard in D₂O.