HUMMEL & CO., INC

#0775-01

Hummel & Co., Inc. • 35 King Street • P.O. Box 606 • Trumansburg, New York 14886 • Phone: (607) 387-5694 • Fax: (607) 387-9499 • Email: soildr1@zoom-DSL.com • Web Site: www.turfdoctor.com

BUNKER SAND TEST REPORT FOR
Ultra White Bunker Sand

REPORT TO: Joe Barabas
Specialty Minerals, Inc.
35 Highland Avenue
Bethlehem, PA 18017

DATE RECEIVED: May 5, 2003
TEST DATES: May 5 - 8, 2003
REPORT DATE: May 9, 2003
CONDITION OF SAMPLE: Normal

PARTICLE SIZE ANALYSIS (ASTM F-1632)

		Soil Separate %			Sieve Size/Sand Fraction Sand Particle Diameter % Retained					
Lab ID No.	**Sample**	**Sand**	**Silt**	**Clay**	**No. 10 Gravel 2 mm**	**No. 18 V. coarse 1 mm**	**No. 35 Coarse 0.5 mm**	**No. 60 Medium 0.25 mm**	**No. 140 Fine 0.10 mm**	**No. 270 V. fine 0.05 mm**
15060-2	Ultra White Sand	98.1	1.4	0.4	0.0	24.7	42.7	22.7	7.2	0.8
	Recommended Values*		$\leq$3%		**$\leq$2%**	**$\leq$15%**		**78 - 100%**		**$\leq$5%**

* From Brown and Thomas, Golf Course Management 54:64-70, 1986.

BUNKER SAND ANALYSIS

Lab ID No.	**Sample**	**Sphericity/Angularity**	**Crusting**	**Color**	**Infiltration Rate (in/hr)**	**Penetrometer Value (kg/cm^2)**	**Interpretation**
15060-2	Ultra White Sand	Low to high/angular to sub-rounded	None	Hue 10YR 8/1 White	42.1	3.30 – Very low tendency to bury the ball.	

Comments: The Ultra White Sand sample (Lab ID No. 15060-2) was tested as received. Per your request, we performed a complete bunker sand analysis on the sample. To evaluate bunker sands we use the criteria published by Brown and Thomas in a 1986 issue of Golf Course Management, guidelines that are the most widely accepted in the industry today.

The sample contained small amounts of silt and clay. As a result, there was no crusting of the sand after wetting and drying. This is desirable because bunkers with this sand in place may not require raking after every rainfall or irrigation event.

The sand does not meet the Brown and Thomas recommendation for particle size distribution because the very coarse sand content is high. While this may not affect performance of the sand in a bunker, it presents a concern where bunkers are adjacent to greens and the coarse particles are blasted up onto the green surface. It is really the subjective opinion of the superintendent as to whether or not this is a problem.

The sand particle shape is mixed, ranging from angular to sub-rounded. Generally, the more angular the sand particles are, the greater the resistance to ball penetration.

To measure the potential of a sand to produce fried egg lies or buried balls, we measure the resistance of the sand to ball penetration using a penetrometer. Values of between 1.8 and 2.4 are considered acceptable according to the Brown and Thomas guidelines. Our testing experience has shown that the more widely accepted sands have values of 2.20 or above. This sand had a penetrometer reading of 3.30, suggesting a very low tendency to bury the ball.

Although the Brown and Thomas bunker sand recommendations do not include an infiltration rate, we suggest a minimum of 15 inches per hour. The infiltration rate was high, so drainage through this sand should not be a problem initially.

These results suggest that this sand has properties that are desirable for use in bunkers. The only potentially negative aspect apparent from our testing was the amount of very coarse sand particles. Despite this testing, bunker sand selection is highly subjective. Aside from playability, factors such as color and aesthetics are often weighed in the decision process. We recommend that golf course superintendents, pros, greens committee chairs, and any other interested parties visit a club with the sand in use. Play into and out of it to see how they like it.

Please let me know if you have any questions on these results. Thank you.

Mary C. Thurn

Mary C. Thurn
Consultant