Delivering the Right Results

FP828
Nitrogen (Protein) Combustion Analysis

2022/07/18

Kevin Lee

LECO Background

- Privately owned U.S. Company for over 75 years
- Headquartered in Saint Joseph, MI



- Diverse Instrumentation offerings
  - Organic and Inorganic Elemental Analysis
  - Mass Spectrometry (TOF)
  - Metallographic Products
  - Microscopy and Image analysis

- 25 LECO subsidiaries representing over 100 countries

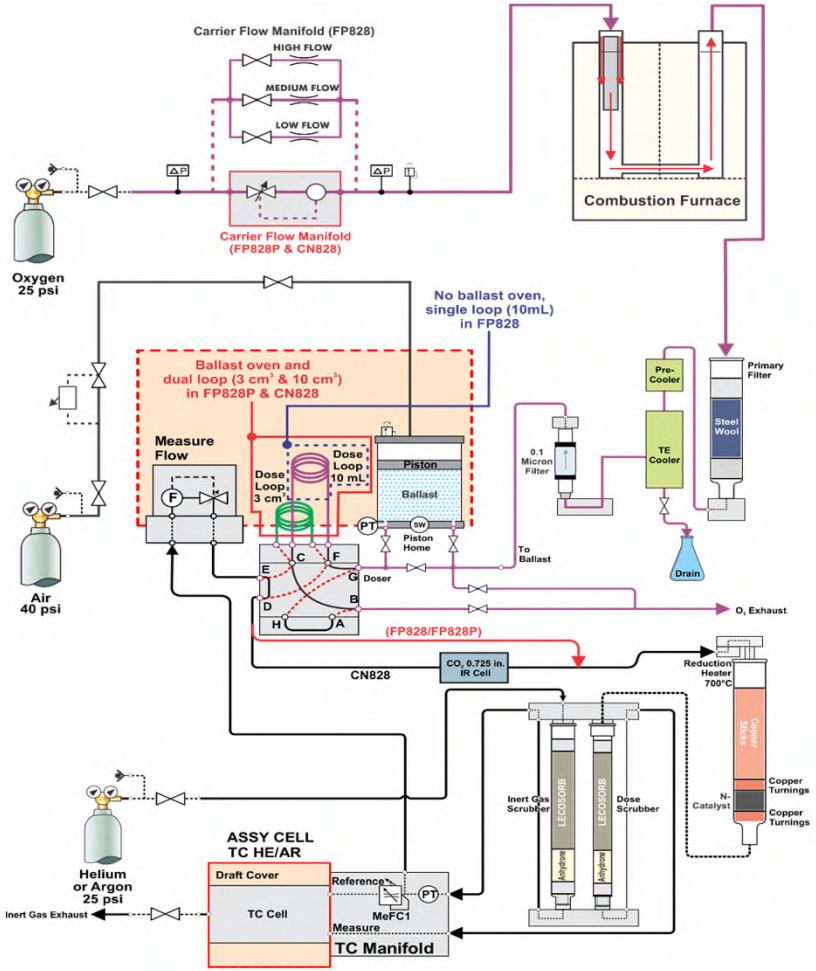
FP828 Applications

- Food and Feeds
- Soils and Plant Tissue
- Agricultural and Agronomy materials
- Animal Science Laboratories
- Commercial Laboratories

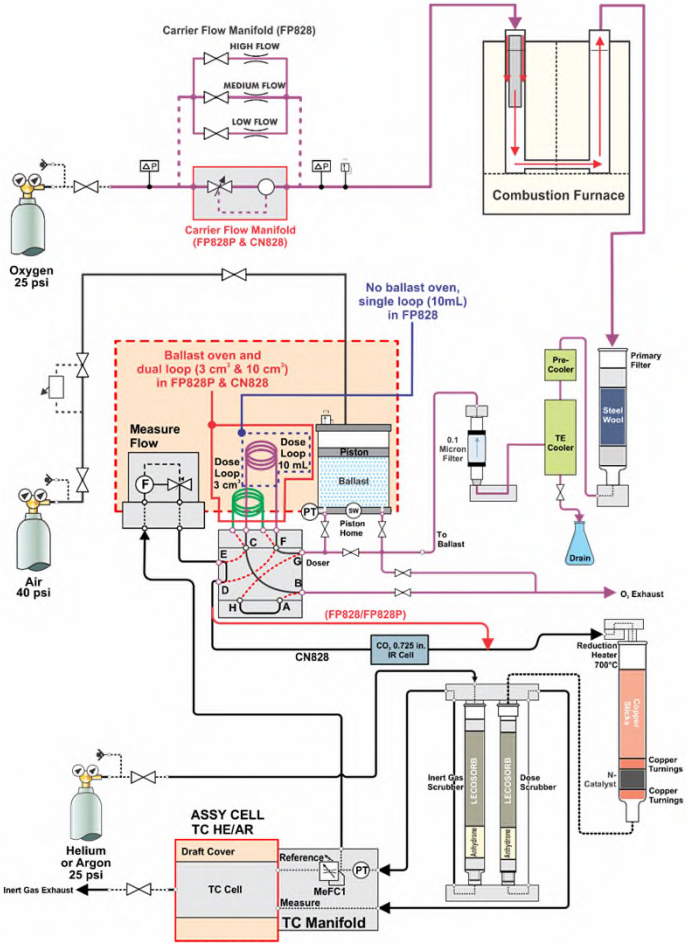
Ideal for most applications

Unparalleled throughput and uptime

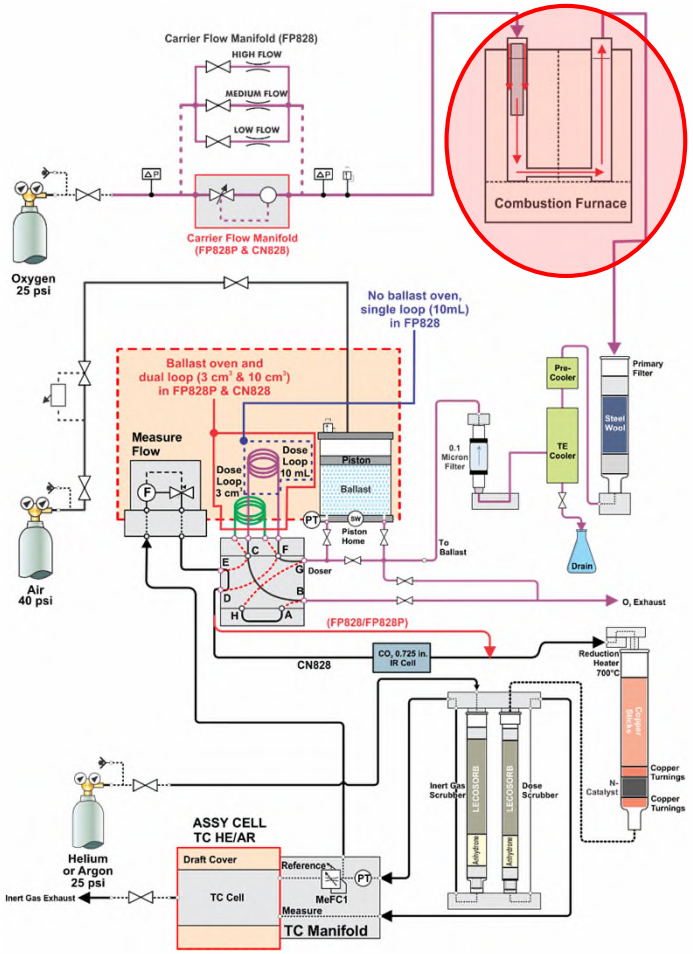
FP828 Theory of Operation



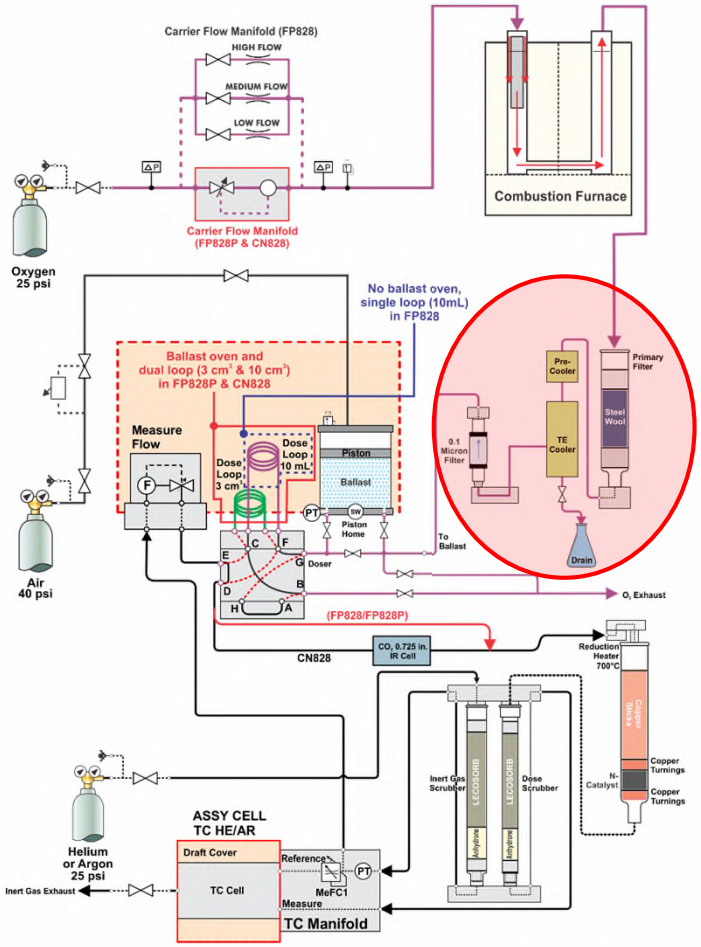
FP/CN828 Theory of Operation

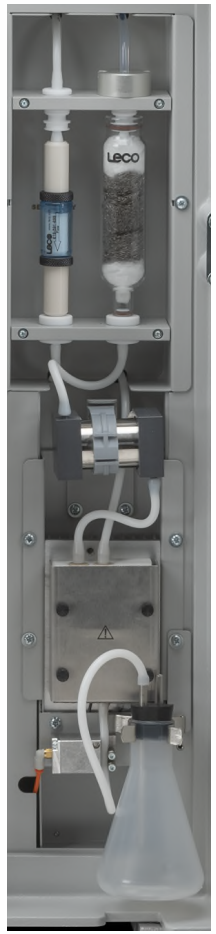


FP/CN828 Theory of Operation

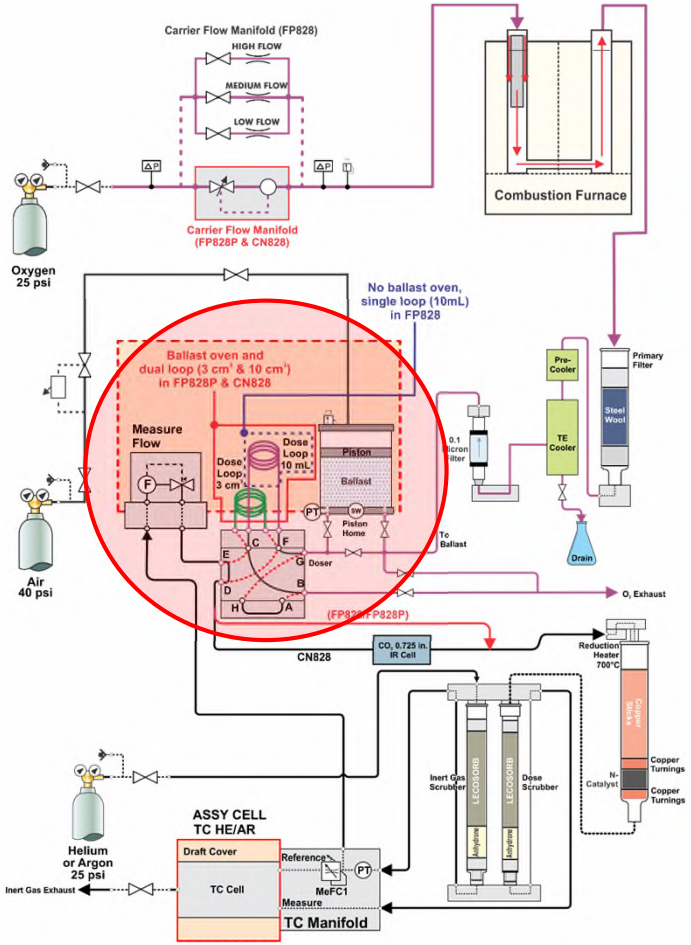


FP/CN828 Theory of Operation

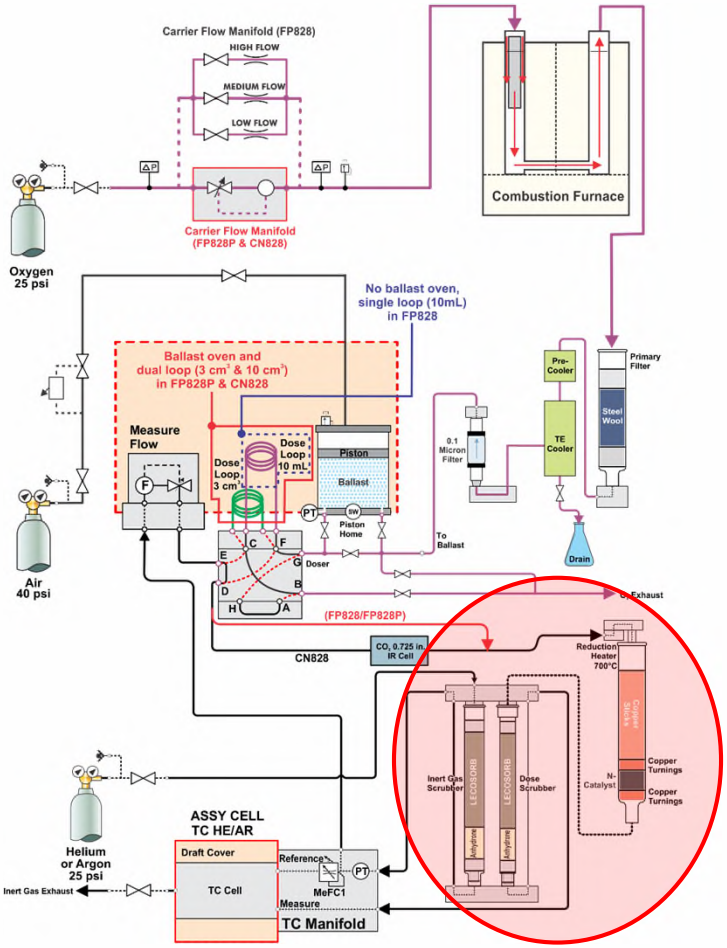




FP/CN828 Theory of Operation



FP/CN828 Theory of Operation



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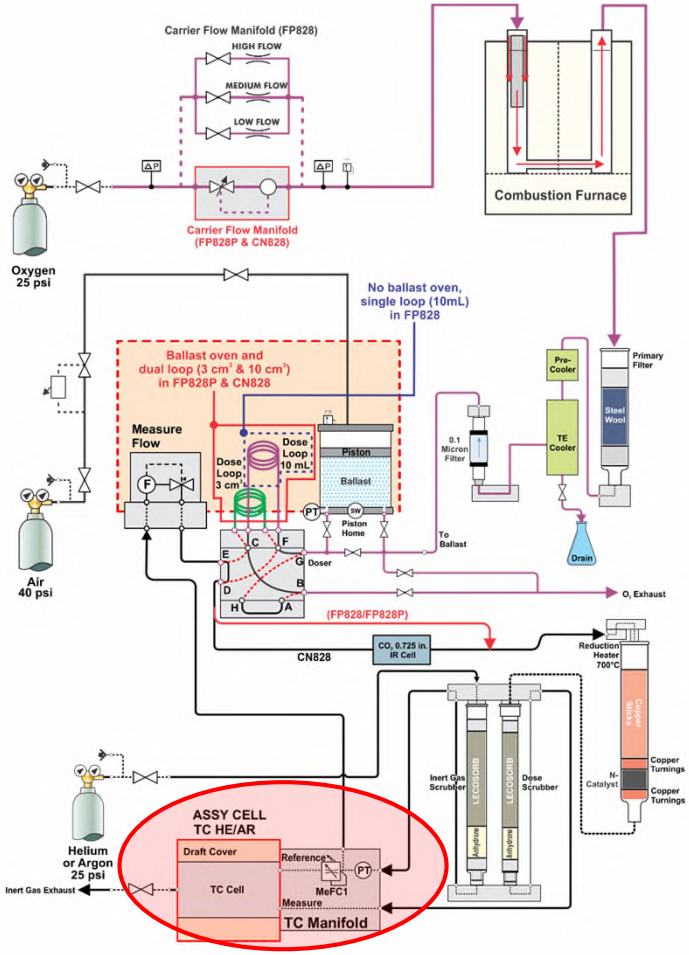
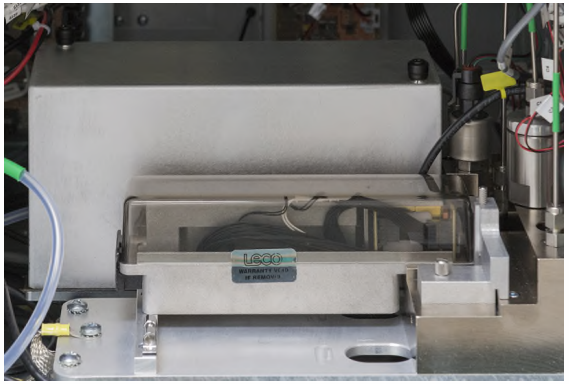
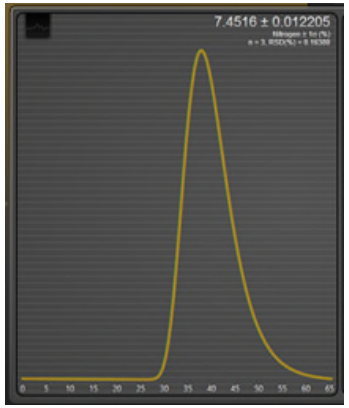


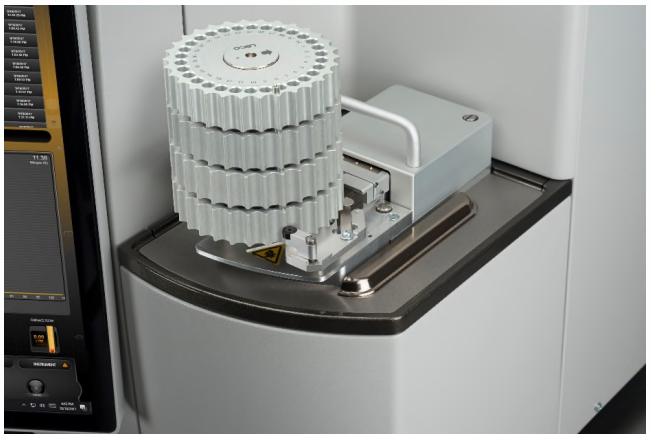




Maximize Efficiency and Productivity

Unparalleled throughput coupled with superior instrument uptime

- Rapid analysis times of 2.8 minutes - 21 results an hour
- Extended reagent lifetimes - reduction reagent tube lifetime of 4,000 samples
- 30 sample position autoloader optional expansion up to 120 sample capacity



Versatility, Superior Uptime and Operating Cost

- Reagent free furnace
- Thermoelectric cooler
- Combustion gas collection and aliquot system
- TC cell supports the use of either helium or argon

Operator Centered Design

- Boom-mounted touch-screen user interface promotes an ergonomic workspace and optimized workflow while reducing system bench space
- Open access to all reagent tubes and common maintenance areas
- Keep updated on analysis batch progress, performance and status using Cornerstone Mobile remote software from your smartphone

Reliability with Trusted Service and Support

- Knowledgeable Sales force with a customer centered focus
- State of the art Technical Service Laboratory with experienced application chemists
- Global LECO service and support network comprised of regional support centers and over 25 international LECO subsidiaries

Application Note

LECO
EMPOWERING RESULTS

Instrument: FP828

Determination of Nitrogen/Protein in Flour

*TYPICAL RESULTS**

	10 cm^3 Helium			3 cm^3 Helium			10 cm^3 Argon			3 cm^3 Argon		
	Mass(g)	*% N*	*% Protein*	*Mass(g)*	*% N*	*% Protein*	*Mass(g)*	*% N*	*% Protein*	*Mass(g)*	*% N*	*% Protein*
Corn Flour LRM	0.2484	1.056	6.60	0.2530	1.050	6.56	0.2596	1.088	6.80	0.2517	1.123	7.02
LECO 501-563†	0.2513	1.048	6.55	0.2475	1.043	6.52	0.2594	1.061	6.63	0.2523	1.102	6.88
Lot 1016	0.2506	1.046	6.54	0.2484	1.050	6.56	0.2409	1.090	6.81	0.2505	1.091	6.82
% N = 1.06	0.2558	1.044	6.52	0.2455	1.047	6.54	0.2572	1.074	6.71	0.2470	1.054	6.59
± 0.03	0.2468	1.055	6.59	0.2513	1.047	6.54	0.2457	1.081	6.76	0.2548	1.085	6.78
†Protein Factor = 6.25	***Avg =***	***1.050***	***6.56***	***Avg =***	***1.048***	***6.55***	***Avg =***	***1.079***	***6.74***	***Avg =***	***1.091***	***6.82***
	s =	***0.005***	***0.03***	***s =***	***0.003***	***0.02***	***s =***	***0.012***	***0.07***	***s =***	***0.025***	***0.16***
Wheat Flour LCRM	0.2571	2.666	15.2	0.2587	2.655	15.1	0.2425	2.643	15.1	0.2560	2.672	15.2
LECO 502-692††	0.2529	2.669	15.2	0.2478	2.648	15.1	0.2556	2.657	15.1	0.2527	2.677	15.3
Lot 1000	0.2508	2.669	15.2	0.2497	2.650	15.1	0.2468	2.643	15.1	0.2481	2.648	15.1
% N = 2.66	0.2436	2.664	15.2	0.2493	2.646	15.1	0.2415	2.665	15.2	0.2438	2.660	15.2
± 0.05	0.2430	2.676	15.3	0.2438	2.633	15.0	0.2481	2.659	15.2	0.2554	2.701	15.4
†Protein Factor = 5.70	***Avg =***	***2.669***	***15.2***	***Avg =***	***2.646***	***15.1***	***Avg =***	***2.653***	***15.1***	***Avg =***	***2.672***	***15.2***
	s =	***0.004***	***0.03***	***s =***	***0.008***	***0.04***	***s =***	***0.010***	***0.05***	***s =***	***0.020***	***0.11***
Rice Flour LCRM	0.2406	1.576	9.38	0.2472	1.550	9.22	0.2542	1.556	9.26	0.2589	1.572	9.35
LECO 502-907‡	0.2506	1.572	9.35	0.2546	1.541	9.17	0.2477	1.562	9.29	0.2461	1.568	9.33
Lot 1000	0.2421	1.577	9.38	0.2413	1.537	9.14	0.2460	1.553	9.24	0.2525	1.509	8.98
% N = 1.56	0.2507	1.569	9.34	0.2600	1.543	9.18	0.2467	1.561	9.29	0.2526	1.550	9.22
± 0.05	0.2574	1.571	9.35	0.2458	1.541	9.17	0.2550	1.568	9.33	0.2459	1.567	9.32
†Protein Factor = 5.95	***Avg =***	***1.573***	***9.36***	***Avg =***	***1.542***	***9.18***	***Avg =***	***1.560***	***9.28***	***Avg =***	***1.553***	***9.24***
	s =	***0.003***	***0.02***	***s =***	***0.005***	***0.03***	***s =***	***0.006***	***0.03***	***s =***	***0.026***	***0.15***

Application Note

Instrument: FP828

Determination of Nitrogen in Fertilizer

LECO Corporation; Saint Joseph, Michigan USA

TYPICAL RESULTS

Data was generated utilizing a linear, forced through origin calibration using ~0.05 g of NIST 913b Uric Acid (33% N). The calibration was verified using LECO 502-896 (Lot 1002) EDTA (9.57% N).

	10 cm² Helium		3 cm² Helium¹		10 cm² Argon		3 cm² Argon¹	
	Mass (g)	% N	Mass (g)	% N	Mass (g)	% N	Mass (g)	% N
Urea	0.0519	46.6	0.0520	46.7	0.0496	46.7	0.0493	46.5
Reagent Grade	0.0490	46.7	0.0496	46.6	0.0544	46.6	0.0546	46.6
Theoretical Value: 46.6% N	0.0497	46.5	0.0503	46.6	0.0500	46.7	0.0468	46.5
	0.0510	46.6	0.0510	46.5	0.0519	46.5	0.0503	46.7
	0.0529	46.6	0.0522	46.6	0.0497	46.6	0.0505	46.8
	0.0493	46.6	0.0531	46.6	0.0543	46.6	0.0491	46.5
	0.0514	46.7	0.0517	46.7	0.0505	46.6	0.0522	46.6
	0.0490	46.6	0.0507	46.7	0.0503	46.7	0.0511	46.7
	0.0506	46.7	0.0493	46.5	0.0516	46.4	0.0516	46.5
	0.0511	46.8	0.0502	46.6	0.0513	46.7	0.0505	46.6
	Avg =	***46.6***	***Avg =***	***46.6***	***Avg =***	***46.6***	***Avg =***	***46.6***
	s =	***0.1***	***s =***	***0.1***	***s =***	***0.1***	***s =***	***0.1***
Ammonium Sulfate	0.0500	21.3	0.0574	21.3	0.0557	21.3	0.0545	21.3
Reagent Grade	0.0530	21.3	0.0541	21.2	0.0538	21.3	0.0484	21.2
Theoretical Value: 21.2% N	0.0518	21.3	0.0524	21.2	0.0532	21.1	0.0475	21.1
	0.0493	21.2	0.0535	21.3	0.0530	21.2	0.0508	21.1
	0.0493	21.2	0.0542	21.2	0.0549	21.2	0.0540	21.1
	0.0518	21.2	0.0541	21.2	0.0524	21.2	0.0559	21.2
	0.0507	21.2	0.0537	21.2	0.0489	21.3	0.0500	21.1
	0.0503	21.2	0.0548	21.2	0.0545	21.2	0.0481	21.0
	0.0531	21.2	0.0521	21.2	0.0573	21.2	0.0514	21.1
	0.0516	21.3	0.0512	21.3	0.0514	21.2	0.0493	21.1
	Avg =	***21.2***	***Avg =***	***21.2***	***Avg =***	***21.2***	***Avg =***	***21.1***
	s =	***<0.1***	***s =***	***0.1***	***s =***	***0.1***	***s =***	***0.1***
Potassium Nitrate	0.0502	13.9	0.0522	13.9	0.0510	13.8	0.0552	13.7
Reagent Grade	0.0515	13.8	0.0508	13.8	0.0510	13.9	0.0535	13.9
Theoretical Value: 13.85% N	0.0536	13.8	0.0486	13.9	0.0481	13.9	0.0538	13.8
	0.0535	13.9	0.0490	13.9	0.0538	13.8	0.0543	13.8
	0.0479	13.8	0.0504	13.8	0.0550	13.8	0.0531	13.8
	0.0520	13.8	0.0533	13.9	0.0549	13.8	0.0552	13.8
	0.0499	13.8	0.0526	13.8	0.0500	13.8	0.0564	13.8
	0.0503	13.8	0.0532	13.8	0.0478	13.9	0.0533	13.9
	0.0502	13.9	0.0497	13.9	0.0518	13.9	0.0486	13.8
	0.0519	13.8	0.0491	13.9	0.0482	13.9	0.0521	13.7
	Avg =	***13.8***	***Avg =***	***13.9***	***Avg =***	***13.8***	***Avg =***	***13.8***
	s =	***<0.1***	***s =***	***<0.1***	***s =***	***0.1***	***s =***	***0.1***

LECO 502-602	1.0003	0.097	1.0057	0.102	0.5245	0.010	0.4984	0.103
Lot# CT-0859	1.0007	0.100	1.0052	0.096	0.5318	0.096	0.4994	0.090
Ammonium Solution	1.0005	0.098	1.0032	0.097	0.5422	0.096	0.4889	0.079
0.10% N	0.9901	0.095	1.0046	0.097	0.5224	0.101	0.4930	0.099
	1.0095	0.100	1.0030	0.095	0.5273	0.096	0.4925	0.104
	1.0150	0.101	1.0663	0.096	0.5320	0.099	0.5006	0.095
	1.0011	0.095	1.0283	0.099	0.5055	0.096	0.4975	0.085
	1.0017	0.100	1.0220	0.092	0.5793	0.102	0.4950	0.102
	1.0016	0.097	1.1001	0.097	0.5355	0.095	0.4995	0.099
	1.0559	0.101	1.0334	0.097	0.5360	0.094	0.4991	0.106
	Avg =	***0.098***	***Avg =***	***0.097***	***Avg =***	***0.097***	***Avg =***	***0.096***
	s =	***0.002***	***s =***	***0.003***	***s =***	***0.003***	***s =***	***0.009***
LECO 502-601	1.0632	0.011	1.0847	0.012	---	"	---	"
Lot# 0006538211	1.0749	0.010	1.0612	0.011	---	"	---	"
Ammonium Solution	1.0641	0.010	1.0541	0.009	---	"	---	"
0.010% N	1.0599	0.011	1.0563	0.010	---	"	---	"
	1.0744	0.010	1.1004	0.012	---	"	---	"
	1.0680	0.009	1.0806	0.010	---	"	---	"
	1.0665	0.010	1.0936	0.011	---	"	---	"
	1.0892	0.010	1.0485	0.011	---	"	---	"
	1.0654	0.010	1.0677	0.011	---	"	---	"
	1.1086	0.011	1.0019	0.009	---	"	---	"
	Avg =	***0.010***	***Avg =***	***0.011***	***Avg =***	***---***	***Avg =***	***---***
	s =	***0.001***	***s =***	***0.001***	***s =***	***---***	***s =***	***---***

Application Note

Instrument: FP828

Determination of Nitrogen/Protein in Feeds, Grains, and Pet Food

LECO Corporation; Saint Joseph, Michigan USA

TYPICAL RESULTS

Data was generated utilizing a single standard, forced through origin calibration using ~ 0.25 g of 502-896 EDTA LCRM Lot #1002 (9.57% N). The calibration was verified using ~ 0.10 g of 502-642 Phenylalanine LCRM Lot #1018 (8.47% N). Samples were analyzed as received and the nitrogen values were then corrected for moisture using the instrument's software. A protein factor of 6.25†† was used for all samples to calculate the protein content.

	Helium			Argon		
	Mass (g)	*Nitrogen (%)*	*Protein (%)*	*Mass (g)*	*Nitrogen (%)*	*Protein (%)*
NIST 3290 Dry Cat Food 32.77 ± 0.30% Protein	0.2794	5.30	33.1	0.2483	5.30	33.1
	0.2603	5.26	32.9	0.2603	5.29	33.0
	0.2524	5.30	33.1	0.2458	5.26	32.9
	0.2577	5.29	33.0	0.2447	5.31	33.2
	0.2546	5.28	33.0	0.2468	5.28	33.0
	Avg =	***5.29***	***33.0***	***Avg =***	***5.29***	***33.0***
	s =	***0.02***	***0.1***	***s =***	***0.02***	***0.1***
Hay	0.2451	3.43	21.4	0.2529	3.41	21.3
	0.2529	3.43	21.5	0.2560	3.45	21.6
	0.2519	3.44	21.5	0.2534	3.43	21.4
	0.2528	3.43	21.5	0.2549	3.40	21.2
	0.2556	3.44	21.5	0.2524	3.42	21.4
	Avg =	***3.43***	***21.5***	***Avg =***	***3.42***	***21.4***
	s =	***0.01***	***0.03***	***s =***	***0.02***	***0.1***
Corn Silage	0.2522	1.10	6.90	0.2497	1.15	7.17
	0.2518	1.11	6.92	0.2492	1.14	7.11
	0.2494	1.10	6.87	0.2492	1.10	6.89
	0.2512	1.10	6.89	0.2475	1.16	7.23
	0.2503	1.09	6.83	0.2527	1.13	7.07
	Avg =	***1.10***	***6.88***	***Avg =***	***1.14***	***7.09***
	s =	***0.01***	***0.03***	***s =***	***0.02***	***0.13***
Distillers Grain	0.2596	5.24	32.8	0.2495	5.19	32.4
	0.2503	5.22	32.6	0.2511	5.17	32.3
	0.2544	5.22	32.6	0.2504	5.22	32.6
	0.2477	5.23	32.7	0.2506	5.23	32.7
	0.2564	5.20	32.5	0.2524	5.23	32.7
	Avg =	***5.22***	***32.6***	***Avg =***	***5.21***	***32.6***
	s =	***0.02***	***0.1***	***s =***	***0.03***	***0.2***
Feed	0.2569	3.87	24.2	0.2567	3.85	24.0
	0.2531	3.76	23.5	0.2479	3.93	24.6
	0.2551	3.89	24.3	0.2531	3.85	24.0
	0.2506	3.88	24.3	0.2470	3.78	23.6
	0.2507	3.84	24.0	0.2606	3.99	24.9
	Avg =	***3.85***	***24.0***	***Avg =***	***3.88***	***24.2***
	s =	***0.05***	***0.3***	***s =***	***0.08***	***0.5***
Corn Grain	0.2540	1.27	7.95	0.2545	1.31	8.16
	0.2557	1.27	7.95	0.2597	1.29	8.03
	0.2554	1.28	8.01	0.2530	1.27	7.92
	0.2479	1.27	7.94	0.2525	1.25	7.83
	0.2542	1.27	7.95	0.2502	1.28	7.99
	Avg =	***1.27***	***7.96***	***Avg =***	***1.28***	***7.99***
	s =	***< 0.01***	***0.03***	***s =***	***0.02***	***0.12***

Application Note

Instrument: FP828

Determination of Nitrogen/Protein in Beer

LECO Corporation; Saint Joseph, Michigan USA

TYPICAL RESULTS

Data was generated utilizing a linear, force through origin calibration using a 0.2% N glycine solution. The calibration was verified using 502-602 Ammonium Solution (0.1% N), and a 0.05% N glycine solution. All samples were weighed and analyzed at ~0.75 g. A protein factor of 6.25[†] was used for all samples to calculate the protein content.

	10 cm^3 Helium			3 cm^3 Helium			10 cm^3 Argon		
	Mass (g)	*% N*	*% Protein*	*Mass (g)*	*% N*	*% Protein*	*Mass (g)*	*% N*	*% Protein*
American IPA	0.7758	0.143	0.896	0.7605	0.140	0.876	0.7560	0.141	0.881
	0.7520	0.145	0.909	0.7574	0.140	0.874	0.7571	0.146	0.909
	0.7615	0.145	0.906	0.7553	0.140	0.873	0.7537	0.150	0.938
	0.7592	0.146	0.912	0.7460	0.145	0.904	0.7742	0.134	0.838
	0.7561	0.143	0.895	0.7657	0.144	0.900	0.7695	0.149	0.933
	Avg =	***0.145***	***0.904***	***Avg =***	***0.142***	***0.885***	***Avg =***	***0.144***	***0.900***
	s =	***0.001***	***0.008***	***s =***	***0.002***	***0.015***	***s =***	***0.007***	***0.041***
Pilsner	0.7622	0.035	0.219	0.7700	0.031	0.195	0.7434	0.035	0.216
	0.7453	0.035	0.218	0.7413	0.031	0.195	0.7459	0.031	0.191
	0.7501	0.035	0.220	0.7625	0.032	0.198	0.7485	0.040	0.250
	0.7528	0.034	0.213	0.7608	0.034	0.214	0.7478	0.027	0.168
	0.7448	0.034	0.214	0.7646	0.034	0.212	0.7572	0.033	0.208
	Avg =	***0.035***	***0.217***	***Avg =***	***0.032***	***0.203***	***Avg =***	***0.033***	***0.207***
	s =	***< 0.001***	***0.003***	***s =***	***0.002***	***0.010***	***s =***	***0.005***	***0.030***
Porter	0.7560	0.113	0.704	0.7499	0.112	0.702	0.7715	0.119	0.745
	0.7466	0.112	0.703	0.7824	0.111	0.695	0.7460	0.114	0.710
	0.7484	0.113	0.707	0.7716	0.113	0.704	0.7584	0.105	0.659
	0.7695	0.112	0.698	0.7692	0.107	0.669	0.7494	0.113	0.709
	0.7754	0.111	0.694	0.7448	0.111	0.692	0.7641	0.110	0.686
	Avg =	***0.112***	***0.701***	***Avg =***	***0.111***	***0.692***	***Avg =***	***0.112***	***0.702***
	s =	***0.001***	***0.005***	***s =***	***0.002***	***0.014***	***s =***	***0.005***	***0.032***

Application Note

Instrument: FP828 Series

LECO
EMPOWERING RESULTS

Determination of Nitrogen/Protein in Milk and Milk Products

LECO Corporation; Saint Joseph, Michigan USA

TYPICAL RESULTS

Data was generated utilizing a linear, force through origin calibration using ~0.25 g of 502-896 LCRM EDTA Lot# 1002 (9.57% N). The calibration was verified using ~0.10 g of 502-642 LCRM Phenylalanine Lot# 1018 (8.47% N) and a prepared 1.0% N Glycine Solution††. A protein factor of 6.38 was used for all samples to calculate the protein content.

	3 cm³ Helium			10 cm³ Argon			3 cm³ Argon		
	Mass (g)	*% N*	*% Protein*	*Mass (g)‡*	*% N*	*% Protein*	*Mass (g)‡*	*% N*	*% Protein*
Whole Milk	0.2785	0.529	3.38	0.5091	0.513	3.28	0.5176	0.519	3.31
	0.2431	0.547	3.49	0.4949	0.520	3.32	0.5207	0.534	3.41
	0.2728	0.537	3.43	0.5104	0.529	3.38	0.5419	0.562	3.59
	0.2610	0.544	3.47	0.5113	0.526	3.36	0.5050	0.525	3.35
	0.2478	0.539	3.44	0.5325	0.510	3.25	0.4902	0.504	3.22
	Avg =	***0.539***	***3.44***	***Avg =***	***0.520***	***3.32***	***Avg =***	***0.529***	***3.37***
	s =	***0.007***	***0.04***	***s =***	***0.008***	***0.05***	***s =***	***0.022***	***0.14***
Skim Milk	0.2639	0.571	3.64	0.5213	0.551	3.52	0.4954	0.531	3.39
	0.2650	0.557	3.55	0.5063	0.546	3.48	0.5355	0.555	3.54
	0.2631	0.565	3.61	0.4988	0.547	3.49	0.5353	0.552	3.52
	0.2784	0.556	3.55	0.5337	0.544	3.47	0.5182	0.541	3.45
	0.2548	0.557	3.55	0.5293	0.549	3.50	0.5524	0.528	3.37
	Avg =	***0.561***	***3.58***	***Avg =***	***0.547***	***3.49***	***Avg =***	***0.541***	***3.45***
	s =	***0.006***	***0.04***	***s =***	***0.003***	***0.02***	***s =***	***0.012***	***0.08***
Half and Half	0.2468	0.486	3.10	0.4953	0.462	2.95	0.5004	0.430	2.75
	0.2402	0.491	3.13	0.5143	0.470	3.00	0.5215	0.484	3.09
	0.2751	0.479	3.06	0.5207	0.462	2.95	0.4971	0.511	3.26
	0.2718	0.481	3.07	0.5152	0.468	2.99	0.4971	0.462	2.95
	0.2558	0.480	3.06	0.4954	0.472	3.01	0.4975	0.468	2.98
	Avg =	***0.484***	***3.08***	***Avg =***	***0.467***	***2.98***	***Avg =***	***0.471***	***3.01***
	s =	***0.005***	***0.03***	***s =***	***0.005***	***0.03***	***s =***	***0.030***	***0.19***

Questions

Delivering the Right Results

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