



# Technical Bulletin

## Information from Phibro Technical Services

### Vistore® Zinc 590 Vistore® Manganese 540

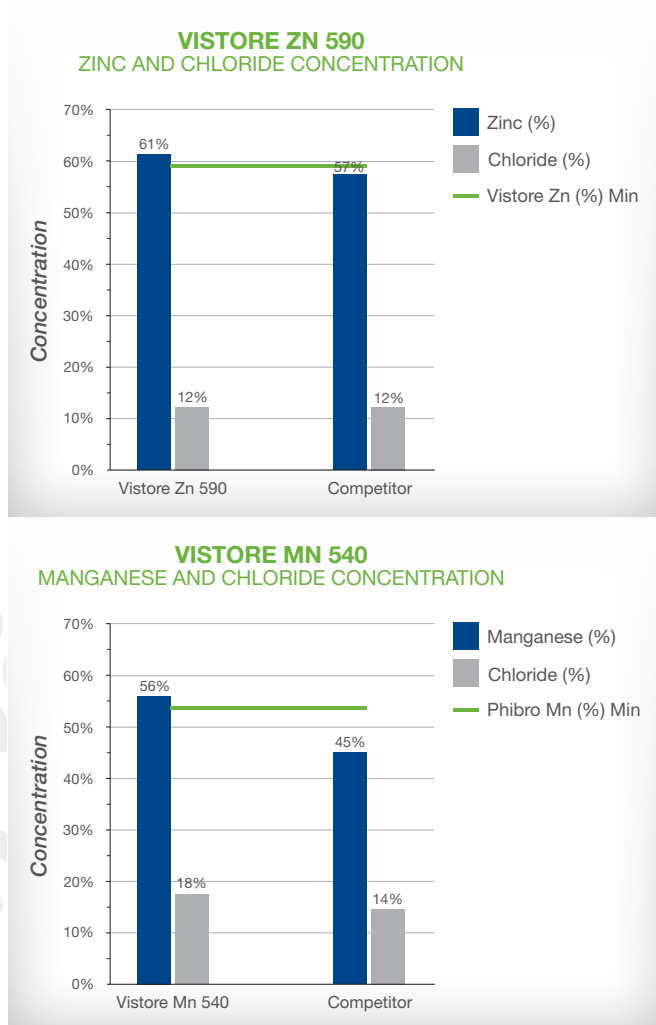
The Vistore mineral portfolio from Phibro Animal Health Corporation includes zinc and manganese. Vistore products are hydroxychloride sourced minerals, which may improve bioavailability over other inorganic mineral sources and reduce the environmental impact associated with the usage of other inorganic sourced minerals. A key piece to ensuring Vistore minerals meet the quality expectations our customers expect is Phibro's Dynamic Quality Assurance® (DQA®) process. Our DQA process monitors the efficacy and safety of Phibro ingredients through detailed, routine analysis. The process takes analysis beyond testing of the major element, zinc (Zn) or manganese (Mn) and contaminants (i.e. Pb, Cd, As, Hg, dioxins and furans), to include a 162 point elemental fingerprint scan and crystal phase identification. All of which helps ensure a high quality, consistent product for our customers every time.



#### Improved Purity

Mineral manufacturing processes can vary significantly, affecting quality and consistency. The DQA process takes a skilled approach at fully understanding the mineral manufacturing process and therefore the final ingredient(s) to ensure high quality, consistent products every time.

Quantification of major elements are determined through elemental analysis. The comparison of Vistore when looking at Zn or Mn and chloride concentrations (for Vistore Zn 590 and Vistore Mn 540) versus the leading competitor are illustrated in Figure 1. Both Vistore products have a higher minimum mineral guarantee (Zn or Mn) than the leading competitor's product, with Vistore Mn 540 concentration being over 10% higher than that of the leading competitor.



**Figure 1. Comparison of Vistore Zn 590 and Vistore Mn 540 Major Elements Versus the Leading Competitor. Phibro Analysis, 2019**

Along with elemental analysis, X-ray diffraction (XRD) supports the high purity of Vistore Zn 590 and Mn 540 products through the identification of crystalline phases. Figure 2 shows the marked difference of Vistore Mn 540 containing only manganese hydroxychloride



and the leading competitor's manganese product detecting manganese hydroxychloride, with manganous oxyhydroxide (MnOOH) also present. Vistore Zn 590 was also found to contain only zinc hydroxychloride, with no detectable oxides compared to the leading competitor's zinc product.

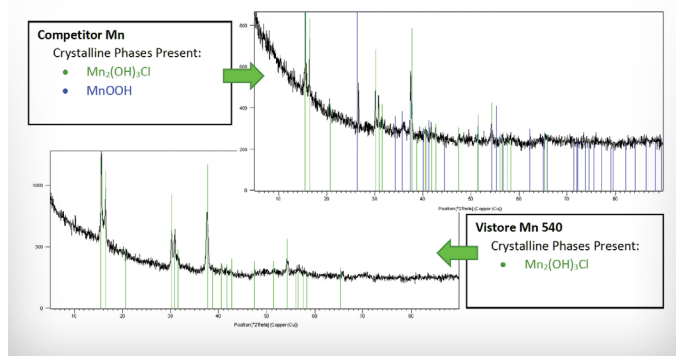


Figure 2. Comparison of XRD Traces for Vistore Mn 540 and Competitor Mn Hydroxychloride. Missouri University of Science and Technology, 2019

### Improved Quality

Identification of secondary minerals and heavy metal contaminants was performed to assist with understanding the composition of different Mn and Zn hydroxychloride products. Vistore Zn 590 data reported slightly lower heavy metal concentrations for most of the heavy metals of concern in comparison to the leading competitor's product (Table 1.). Vistore Mn 540 had lower heavy metal concentrations for arsenic, cadmium and chromium. Analysis of secondary elements in hydroxychloride Mn products showed the leading competitor's Mn product contained a high level of non-target elements (Table 2.), accounting for the much lower Mn concentration in that competitive product.

Table 1.

ELEMENT	Zinc		Manganese	
	VISTORE ZN 590	COMPETITOR	VISTORE MN 540	COMPETITOR
Pb (ppm)	3.0	8.4	31	41
As (ppm)	< 0.25	0.49	1.4	40
Cd (ppm)	< 0.25	2.0	< 0.25	3.3
Cr (ppm)	1.1	1.0	1.7	55
Hg (ppm)	<0.05	<0.05	<0.05	<0.05

Phibro analysis, 2019

Table 2.

Secondary Elements	Vistore Mn 540	Competitor Mn
% Al	0.0110	2.52
% Ca	0.0212	0.180
% Co	0.0642	0.0901
% Cu	0.0213	0.0490
% Fe	0.184	3.27
% K	0.0026	0.545
% Mg	< 0.0005	0.0534
% P	0.0008	0.0961
% SiO2	<0.0010	1.39

Phibro analysis, 2019

### Conclusion

Phibro understands the risks that can be associated with raw mineral materials and the manufacturing processes, and we have the proper programs in place to ensure a high quality, consistent hydroxychloride mineral product is available for our customers.

- Vistore Zn 590
  - 5% more concentrated than the leading competitive product tested
  - Less heavy metal contaminants versus the leading competitor product tested
- Vistore Mn 540
  - 10% more concentrated than the leading competitive product tested
  - Fewer heavy metal and secondary element contaminants versus the leading competitor's product tested
- Phibro DQA processes are in place to help ensure high quality, safe, consistent and efficacious product to our customers every time

