

# EDXRF Potentials - Food, Fodder & Beverage (and Fertilizers & Cosmetics)

## ED-XRF Applications

| Application   | Objective  | Concentration Range  | Requirements   |
|---|--|--|--|
| <b>Food</b>   |  |  |  |
| <b>Fe</b> in Milk Powder and Whey Protein                             | improve nutritional quality of the final product by monitoring Iron when interfering amounts of K, Ca, and Zn are present  | 40-150 ppm   | an absolute measurement precision of +/- 1 -2 ppm is desired |
| <b>Ca</b> in Milk Powder  | interfering elements: P, S, Cl, K  | LLD – 6 %  |  |
| <b>Cd, Al</b> in Milk Powder  | to check that these hazardous elements are below detection limit   | < LLD  |  |
| <b>Fe</b> in Flour, rice and other grains                             | Grains and processed flour have long been fortified with iron.   |  |  |
| <b>Na, Mg, K, and Ca</b> in Ash of Flour                              | The ash that remains when flour is burned is composed primarily of Na, Mg, K, and Ca oxides. The ash percentage and composition have an affect on taste and mouth feel of product made from flour, so they are routinely analyzed. |  |  |
| <b>Al, and P</b> in Dough   | Aluminum and phosphorus are two more elements in addition to iron that are usually in dough.   |  |  |
| <b>Ti</b> in Cookies and Snack Cakes                                  | Titanium dioxide is used to make cookies cakes and fillings whiter and brighter.   |  |  |
| <b>K and Ca</b> in Seasoning  | improve taste and maintain quality of the final product  | K: 0.70 – 1.4 %<br>Ca: 0.5 – 0.9 %                           | fast analysis  |
| Salt ( <b>Cl</b> ) in Margarine & Mayonnaise                          |  | LLD – 0.9 %  |  |
| Salt ( <b>Cl</b> ) in Flavored Coatings on Snack Foods and Seasonings | such as nacho cheese tortilla chips, sour cream, onion potato chips, dill pickle, vinegar, ...<br>Chlorine is monitored to control taste or assure compliance with low salt labeling of products.                                  | LLD: 1.5 – 2.5 % (unseasoned)<br>LLD: 2.0 – 3.5 % (seasoned) | precision better 2 % rel.                                    |
| Salt ( <b>Cl</b> ) and <b>P</b> in Cheese                             | interfering elements: S, K, Ca   | Cl: 1.0 – 3.5 %<br>P: 0.7 – 1.1 %                            |  |
| Salt ( <b>Cl</b> ) and <b>P</b> in processed Cheese                   | (Na <sub>2</sub> HPO <sub>4</sub> = preservative), insure consistency in flavor and maintain proper shelf-life   | Cl: 1.9 – 2.3 %<br>P: 0.8 – 4.5 %                            | accuracy better 0.01 % abs. for NaCl                         |

| Application                             | Objective  | Concentration Range | Requirements        |
|---|--|---------------------|---------------------|
| <b>Beverage</b>                         |  |                     |                     |
| Ca in Orange Juice                      | Ca is often added as a nutritional supplement (for the prevention of osteoporosis) | 0.09 – 1.14 %       |                     |
| <b>S</b> (sulfites) in Wine and Liquors |  |                     |                     |
| <b>Others</b>                           |  |                     |                     |
| P in Tobacco                            | Quality control  | 2.5 – 6.5 %         | fast analysis (10s) |
|   |  |                     |                     |

| Application  | Objective  | Concentration Range  | Requirements |
|--|--|--|--------------|
| <b>Animal Feed &amp; Fodder</b>  |  |  |              |
| <b>P</b> and <b>S</b> in Animal Feed (acidic process solution)   | Analysis of phosphorous pentoxide and sulfates in acidic solution containing interfering amounts of calcium oxide  | SO <sub>4</sub> : 1.5 – 3.5 %<br>P <sub>2</sub> O <sub>5</sub> : 25 – 33 %<br>in process water:<br>P <sub>2</sub> O <sub>5</sub> : 1 – 2 % |              |
| <b>P</b> and <b>Ca</b> in ground Animal Feed   |  | P: 17 – 23 %<br>Ca: 15 – 21 %  |              |
| <b>P</b> , <b>K</b> and <b>Ca</b> in Animal Feed   | Non-ruminants require around 1 % feed <b>phosphates</b> and ruminants about half that. Generally large animals such as beef cattle require 1.1-1.2 % <b>CaCO<sub>3</sub></b> in feed. Layer and meat chickens require around 3 % CaCO <sub>3</sub> .   | P: 0.4 – 1.1 %<br>K: 0.3 – 0.8 %<br>Ca: 0.4 – 1.6 %  |              |
| <b>Na</b> , <b>Mg</b> , <b>P</b> , <b>Cl</b> , <b>K</b> , <b>Mn</b> , <b>Fe</b> , and <b>Zn</b> in Animal Feed and Pet Foods | to control the nutritional value of the products. Magnesia ( <b>MgO</b> ) is very important for ruminant livestock and especially for grazing and lactating animals during spring and autumn, as there is a risk of Mg deficiency which can lead to tetany or grass staggers. Salt ( <b>Na</b> ) is essential for all animals. Main consumers are cattle and chickens. |  |              |
| <b>Cu</b> , <b>I</b> , <b>Zn</b> , <b>Co</b> , <b>FeOxide</b> , <b>Se</b>  | These are nutritional trace elements.  |  |              |
|  |  |  |              |

| Application                                    | Objective   | Concentration Range   | Requirements   |
|--|---|---|--|
| <b>Fertilizer</b>                              |   |   |  |
| <b>Ca and P</b> in Nitric Acid Solutions       | Important for production of fertilizers   | Ca: LLD – 2.5 %<br>P: LLD – 2.0 %                               | fast analysis  |
| <b>P and S</b> in Powdered Fertilizer          | Phosphate rock ( $\text{Ca}_3(\text{PO}_4)_2$ ) is ground and treated with sulfuric acid ( $\text{H}_2\text{SO}_4$ ) to produce phosphoric acid and calcium phosphate salts. Ammonia as a source of N is reacted with the phosphoric acid to produce a base fertilizer solution of plant nutrients. Additional nutrients are added including K, Zn, S from ammonium sulfate and zinc sulfate. | $\text{P}_2\text{O}_5$ : 46 – 53 %<br>$\text{SO}_4$ : 5.5 – 7 % | further elements of interest can be: N, Mg, Al, K, Ca, Fe, Zn, Mn, Cu, and Mo. |
| <b>P and S</b> in Liquid Fertilizer            |   | $\text{P}_2\text{O}_5$ : 24 – 31 %<br>$\text{SO}_4$ : 1 – 5 %   |  |
| <b>Mg, K, Ca</b> in natural Lime and Limestone | to improve nutritinal quality   |   |  |
|  |   |   |  |

| Application   | Objective  | Concentration Range  | Requirements                            |
|---|--|--|---|
| <b>Cosmetics</b>  |  |  |   |
| <b>Ti, Fe and Cr</b> in Body Lotion                                       | Quality control and product classification (sunscreen lotion and cosmetic products)  | TiO <sub>2</sub> : 2 – 7 %<br>Fe <sub>2</sub> O <sub>3</sub> : 1 – 6 %<br>Cr <sub>2</sub> O <sub>3</sub> : 0.1 – 0.9 % |   |
| <b>Ti</b> in Sunscreen Products   | TiO <sub>2</sub> is one of several materials that is used as an effective sunblocking agent. Control of protective factor  | TiO <sub>2</sub> : 0.5 – 8 %   |   |
| <b>Ti, Zn, Bi</b> in Cosmetics and Pomade                                 | QC   | TiO <sub>2</sub> : 12 – 20 %<br>ZnO: 1.4 – 1.5 %<br>BiO: ?   | precision better 1 % rel.               |
| <b>Pb, Cl, SO<sub>4</sub>, Al, Cu, Ni, Fe</b> in Cosmetics                | to check that these hazardous elements are below the detection limit   | < LLD  |   |
| <b>Se</b> in Cosmetic raw materials                                       | in talcs and shampoos  | LLD – 2.5 %  |   |
| <b>Si</b> in Lotion   | Si content determines important physical properties  | 0.5 – 2.5 %  |   |
| <b>Si, Zn</b> in Shampoo and conditioner                                  | for QC and product classification  | Si: LLD – 2.5 %<br>Zn: LLD – 2 %   | Si may be analysed on test hair samples |
| <b>CaO/P<sub>2</sub>O<sub>5</sub></b> ratio in polish agent in Toothpaste | Calcium phosphate is often used as a polishing agent in toothpaste, CaP slurry deluted in nitric acid solutions  | Ca/P-ratio:<br>0.3 – 0.5   |   |
| <b>Cl and Ti</b> in Toothpaste  | Triclosan (Cl) acts as an antiplaque agent, TiO <sub>2</sub> affects color and is often used for it's mildly abrasive properties. Also present in the toothpaste matrix is Ca as CaCO <sub>3</sub> . | Cl: 0.2 – 0.7 %<br>TiO <sub>2</sub> : 0.5 – 1.5 %  |   |
| <b>Al, Cl, and Zr</b> in anti-perspirant Deodorant                        | QC and costs; The quality of the anti-perspirant depends on the concentration of aluminium zirconium tetrachlorohydrate glycine which is the moisture absorption agent in deodorants                 | Zr: LLD – 4 %<br>Cl: LLD – 5 %<br>Al: LLD – 4 %  |   |
| <b>Si</b> in Lipstick and Lip balms                                       | Si content determines important physical properties, such as texture on the lips and «slippiness »   |  |   |
|   |  |  |   |
|   |  |  |   |