Q.: The production of higher strength cements is being requested by concrete producers and there is also a general trend to manufacture finer cements. This means that grinding aids have to be introduced. What are the most reliable and appropriate ones on the market?

A.: Concrete, the most widely used construction material, is evolving year by year. Modern concrete is more than a simple mixture of cement, water, and aggregates: its mix design requires highly skilled technicians and first class ingredients. Among these, cement is by far the most important. Building industry is always looking for cements with high performances levels: it is not unlikely to have type I cements reaching more than 25 MPa compressive strengths in mortar test after 24 h hydration (according to standard test EN 196). These performances are basically obtained by accurate control of clinker chemistry (trying to maximise the amount and reactivity of C_3S) and cement fineness. In order to reach the required fineness levels the use of a suitable grinding aid is mandatory.
Several types of products can be found on the market, ranging from pure grinding aids (specifically designed to increase production and fineness) to products usually called performance enhancers (formulated not only for production increase, but also able to modify the cement hydration in order to improve cement performances).
While choosing the most reliable and appropriate, several parameters should be taken into account: targets we want to reach, type of cement (pure OPC, blended cement), clinker chemistry and reactivity, grinding plant characteristics (ball mill, vertical mill). This means that a good interaction between lab researchers (skilled in cement chemistry) and grinding specialist (with practical field experience) is the best way to formulate the most appropriate product, that should be first designed in a detailed laboratory investigation and then tested through a long-term and reliable industrial trial. Just to summarise, the chose of the most suitable grinding aid is strictly related to level of assistance that the supplier is able to provide.

Q.: It happens sometimes that the hexavalent chromium levels of a clinker and of cements made with the same clinker do not follow any logic, having higher amounts of Cr(VI) in cements than in pure clinker. What are the reasons of these strange results?

A.: If we try to evaluate the Cr(VI) level of a pure clinker (according to the standard test EN 196-10, after clinker grinding) sometimes we find that no Cr(VI) is present. If we grind the same clinker with gypsum reproducing a cement and we check the Cr(VI) of this cement it happens to find higher values. The reason of this lies in the fact that chromate ion (the compounds formed by the hexavalent chromium in alkaline solution) is not simply dissolved in water, but participates to cement hydration. In fact, the chromate, having the same charge and a similar ionic radius of sulphate, can have a similar behavior and form hydration products with structure similar to sulphoaluminate such as ettringite.
If pure clinker is mixed with water, the soluble chromates react with tricalcium aluminate and are immobilized in an ettringite-like structure phase. If gypsum (or others forms of calcium sulphate) is present, then the sulphate concentration in solution increases and the usual sulphoaluminates are formed, leading to the release of Cr(VI). In practice, chromium can be immobilised in hydration products of pure clinker, but it is released if clinker is mixed with gypsum. The parameters that modify the reactivity and the formation of ettringite during the hydration of a Portland cement (fineness, type of gypsum, chemical additives) can have a strong influence on the release of Cr(VI).
This is not a simple "laboratory curiosity": during the evaluation of a new clinker source, grinding plants take into account the level of Cr(VI), since a low level of chromates means lower production cost of cement. It is important to evaluate the Cr(VI) content of a clinker by performing the analysis on a mix of clinker and gypsum, in order to have a clear indication of which will be the Cr(VI) release of cements made with the same clinker.