



the Sign of Quality

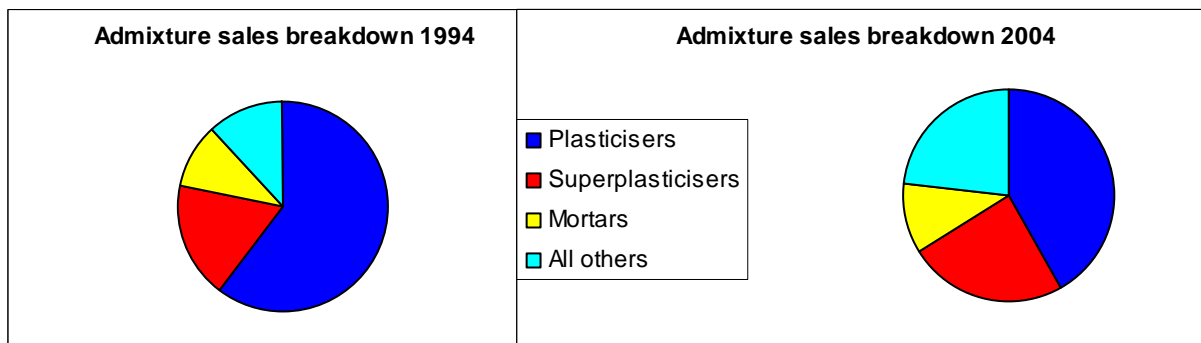
Admixture Current Practice Part 1.

This admixture Current Practice sheet provides background information on current admixtures use. Part 2 looks in more detail at admixtures, what they are, how they work and how they are used.

Overview

Admixture sales have grown steadily over the last 15 to 20 years and current statistics suggest that over 75% of ready-mixed, site-mixed and precast concrete now uses an admixture. This makes admixtures a normal constituent of concrete but possibly not one where the benefits are being fully utilised.

Figure 1 shows a breakdown of current admixture sales by type for 1994 and 2004.



Total sales have more than doubled over this period and show that superplasticisers and 'other' special purpose admixtures have become more important but that normal plasticisers remain the dominant admixture type. This split between superplasticisers and plasticisers is much lower than most other Europe countries and probably reflects the fact that the UK still tends to specify a 50 or 75 mm slump concrete which, by modern standards is unnecessarily unworkable and difficult to place. In 2004 the UK split was 36% superplasticiser against a European average of 56% with countries like Sweden, Switzerland and Italy running at over 90%.

Applications

Admixture types and their applications are well documented and Concrete Society Technical Report 18: 'A guide to the selection of admixtures for concrete', revised in 2002 remains a good reference source.

The main areas of application can be summarised as:

- Economic - Optimised mix design
- Placing - appropriate workability, compactability, cohesion, setting and strength development
- Problem Solving - concrete that will meet special needs for placing or performance
- Durability - helping to ensure that concrete fulfils its design requirements for its intended life
- Environmental - helping to reduce the health and safety aspects of concrete during placing and environmental impact during its life cycle.

A single admixture can often fulfil several of the above functions if used at an appropriate dose. However, there are situations that require two or more admixtures and UK suppliers provide an excellent technical advice services to help meet specific needs and optimise admixture use and performance.

The continued preference for many concrete purchasers to specify 50 or 75 mm slump concrete is perplexing. Handling, placing and compacting concrete at this consistence is difficult and it is not surprising that anecdotal evidence points to the frequent addition of unauthorised water to increase the slump. The cost of admixture use to achieve the same result is minimal and results in a higher quality, more durable concrete. Raising the normally specified consistence class must be a primary goal for both the admixture and the concrete industries.

Technology

The biggest change in technology has been the introduction of PCE (polycarboxylate ether) based plasticisers and superplasticisers. Previous generations of cement dispersants were mainly based on lignosulphonates or sulphonated melamine or naphthalene formaldehyde condensates. The basic chemical structure was fixed and differences in performance were achieved according to molecular weight, purity, blending and the introduction of secondary chemicals to modify the properties.

These options are all possible with PCE polymers but the basic PCE polymer structure can also be modified to change the performance in relation to concrete properties such as workability retention, cohesion and rate of strength development. In addition, the dispersing effect of PCE superplasticisers has a relatively linear relationship over a significant dosage range. This has allowed these chemicals to be used in a cost effective way to meet the requirements of both plasticising and superplasticising admixtures as defined by current standards and to provide multi range products to meet individual customer needs.

Technology has also moved on in other areas as admixture producers have used their expertise to meet specific needs within the concrete industry. As a result we now have mortars which maintain good consistence over an extended working life of 36 hours or more. Concrete with extended workability but that can be made to set quickly at the point of use. Sprayed concrete that is non-corrosive and safe in use. Water resisting admixtures have been developed that reduce concrete permeability even at significant water pressures and viscosity modifying admixtures are now available that improve cohesion and reduce segregation without significant impact on consistence.

Innovation

Admixtures have often been the key to innovation in the concrete industry and admixture manufacturers work with designers and leading concrete engineers to develop novel properties that continue to make concrete the premier choice of construction material in the 21st century. The most recent example of this is the development of self-compacting concrete SCC. This cohesive but highly fluid concrete could not be produced without admixtures and has revolutionised parts of the concrete industry. All major precast plants now use SCC for improvements to the working environment, speed of placing and excellent quality of surface finish, see figure 2. On sites, SCC has allowed concrete to be placed in ways that would not previously have been possible, opening the opportunity for novel design of concrete structures.

Standards

The old British standard for concrete admixtures BS 5075 has been withdrawn and replaced by a harmonised European standard BS EN 934-2. This standard includes an extended range of admixture types covering; plasticisers, superplasticisers, retarders, accelerators, air entraining, water retaining and water resisting admixtures. Because it is a harmonised standard, admixture shown to comply with its requirements under initial type testing (ITT) are then subject to regular surveillance by a Notified Body for factory production control (FPC) and can then be CE marked.

The old British standard for mortar admixtures BS 4887 is about to be withdrawn as a new harmonised European standard BS EN 934-3 has replaced it. This standard currently covers the same admixture types as BS 4887 and like the concrete admixtures, will allow for CE marking.

There are two additional parts of harmonised European standard BS EN 934. Part 4 is already published and covers admixtures for prestressing grouts. Part 5 should be published in 2006 and will cover admixtures for sprayed concrete.

Not all admixture types are covered by EN 934 so the Cement Admixture Association (CAA) are currently working with BSI to develop a new British Standard BS8443 to cover the following; underwater concrete admixtures, shrinkage reducing admixtures, corrosion inhibiting admixtures, pumping aids, segregation reducing admixtures, foaming admixtures, semi-dry concrete admixtures. A draft is currently available as 'CAA guidelines for established suitability' and can be obtained as a free download from their web site www.admixtures.org.uk.

Quality

Admixtures are probably the least variable of any concrete component. Constituents are either synthetic or highly refined and carefully controlled both before and after delivery to the admixture manufacturer. Admixture production uses modern control processes and quality is monitored with an increasing use of analytical equipment to confirm both the nature and content of the components. In addition, EN 934 requires routine testing of the admixtures in a concrete mix to confirm compliance with the requirements of that standard.

Environment

Admixtures are used at a very low dosage in concrete, typically less than 0.15% by weight of active chemical and as a result, their direct environmental impact is so small as to be negligible. However, if they are used to optimise the strength and workability of a concrete mix, a life cycle analysis (LCA) will usually show that the environmental profile of the concrete has been improved, especially in relation to energy and greenhouse gas impact categories. The European Federation of Concrete Admixture Associations (EFCA) has produced environmental product declarations (EPD) on the main admixture types and these are available on the CAA web site.

Admixture manufacturers take environmental issues very seriously and most CAA members have ISO 14000 environmental accreditation for their manufacturing plants. Unlike 20 years ago, most admixture components are no longer waste materials but many are based on highly refined natural products from renewable sources.

Technical Information and support

Members of the UK Cement Admixture Association (CAA) are required to provide technical information and support services that include trials and on-site support if necessary. The association can also give general advice and will arrange impartial talks on specific or general aspects of admixture technology and use. For further information, visit the CAA web site: www.admixtures.org.uk.

