5a

Cement

Portland Cement

Portland cement (which is mostly calcium silicates) is what holds the aggregates together and is available in different grades and colours. It is usually sold in 94 lb. or 50 kg bags. The type you can buy at the local hardware or lumber store is grey in colour. Cement types are defined in the U.S.A. (and some other countries) by ASTM C150, Standards Specification for Portland Cement. In Canada, CSA A5 defines the requirements for Portland cements, and other countries generally have their own specifications. Cements from different sources, even of the same type, may behave slightly differently with respect to set time, strength gain, and interactions with admixtures or pozzolans. These are the U.S.A. ASTM standards, with Canadian CSA types in brackets that I have obtained from the Portland Cement Association, http://www.portcement.org/cb/concretebasics_history.asp:

Type I (Type 10): is a normal, general-purpose cement suitable for all uses. It is used in general construction projects. For all intents and purposes this is the Portland cement you can locate easily and is the one to use.

Type II (Type 20): generates heat at a slower rate and has a moderate resistance to sulfate attack.

Type III (Type 30): is high-early-strength cement and causes concrete to set and gain strength rapidly. It is chemically and physically similar to Type I, except with finer particles. This may increase water demand and lower long-term strength.

Type IV (Type 40): has a low heat of hydration and develops strength at a slower rate than other cement types. It is rarely produced any more.

Type V (Type 50): is used only in concrete structures that will be exposed to severe sulfate action.

When an **A** appears after the type, e.g. "Type IA," the cement has an air-entraining agent already added. Some cements have two designations, e.g. Type I/II fits the requirements of both types.

White Portland cement has been manufactured largely free of iron and magnesium, resulting in a pure white powder, with no loss of strength compared to grey Portland cement. But it is more expensive and not as readily available. It is used where the colour has to be white or a pastel pigmented shade.

Blended Cements

These cements are a blend of Portland cement with other ingredients such as pozzolans (fly ash, silica fume, blast-furnace slag, see **5c OTHER MATERIALS**) for particular applications and they're slowly becoming more popular. By replacing Portland cement and using recycled materials, they are also more environmentally friendly. If you can find them they may also be more convenient than adding pozzolans yourself. As one example: Type IS has between 25% and 75% blast-furnace slag. Some of their different characteristics could include: lower heat, slower strength gain, higher ultimate strength, lower permeability, better durability. Some may need longer curing to achieve these properties. ASTM C 595 specifications list the following types in the U.S.A.:

Type IS: Portland blast-furnace slag cement
Type IP and Type P: Portland-pozzolan cement
Type I(PM): Pozzolan-modified Portland cement
Type S: Slag cement
Type I(SM): Slag-modified Portland cement

Canada's CSA A362 standard allows five types of blended cement:

Type 10S: Portland blast-furnace slag cement
Type 10SM: slag-modified Portland cement
Type 10F: Portland fly ash cement
Type 10FM: fly ash-modified Portland cement
Type10SF: Portland silica fume cement

(Source: Portland Cement Association publication: PCA R&D Serial No. 2475, ISBN 0-89312-203-3)

WARNING!

Skin contact: Avoid all skin contact. Cement is caustic like lye (alkaline, pH 12 to 13) when mixed with water and not cured. Wet Portland cement will not only cause **skin irritation, it can also cause irreversible tissue damage, including third-degree burns**. Don't rely on pain or discomfort as an indicator at the time; several hours later the damage may become apparent.

As well, you may develop defatting dermatitis or **allergic dermatitis** because of chromium contaminants in the cement. Once you develop this sensitivity to cement, in the form of a skin allergy, you may not be able to use it any more. So use preventive measures to make sure you do not become sensitized. **Wear protective gloves** (a minimum of latex or vinyl – replace them when they are torn) and long sleeves. A barrier cream is not sufficient. If you get wet cement on your skin wash it immediately with soap and water.

Serious eye damage, ranging from irritation to burns and blindness: The chemical compounds in Portland cement are highly corrosive to the eyes. Wear safety glasses with side shields, or goggles.

Lungs: Airborne dry cement dust can cause immediate or delayed irritation or inflammation; wear a mask (respirator) rated for cement dust. Portland cement can have trace amounts of crystalline silica dust, which can lead to **silicosis**, a potentially fatal lung disease. If you get concrete dust in your clothes, clean them. Don't wear them around the house. Avoid methods of working which would add dust to the air. And don't eat or drink in the work area.

First aid: for eyes, flush with water for at least 15 minutes and seek medical attention. For skin: flush thoroughly with water. For inhalation: remove to fresh air. For ingestion: give victim water and seek medical attention.

Cement can also be a hazard to your plumbing. Do not wash your tools in the sink. The unset concrete may harden in your plumbing. Always wash tools in a separate container and let it settle for at least a day. Pour off the water and dispose of the concrete.

High Alumina Cement

High alumina cement (HAC) is often called ciment fondu. See the separate chapter on **CIMENT FONDU**.

WARNING!

Ciment fondu is considered a nuisance dust, and an irritant to eyes, skin, nose and throat. Wear a dust mask, eye protection and gloves.