Improving your Bottom Line:

Using Fly Ash and Ground Blast Furnace Slag (GBFS) in concrete mixes as partial substitutes for Cement

- Many of the older concrete batching plants, often in lower turn-over areas have a single cement silo and some provisions for selected additives.
- Prolonging the life of the Plant will always be a major driver, but increasing its versatility is of almost equal importance.
- With the regular increases in the cost of GP and Special Purpose cement products, we think it make sense to look at ways to lower your production costs and at the same time, increase the quality of your concrete mixes and provide more production options.

- One of the ways to achieve a production cost reduction is to add a second silo to a single silo plant for additions of Fly Ash and/or GBFS
- For economy of installation, an excellent option here is to install a bolted panel silo, designed for containerised transport and to be a relatively straightforward installation.
- Sourced and designed through a reliable Australian Company familiar with all relevant Australian Standards, these silos are not overly expensive to purchase.

Three more points for consideration:

- Adding Fly Ash and/or GBFS as substitutes for cement powder will reduce the final mix cost and should result in higher quality mixes.
- The capital cost of a second silo and screw feeder to connect in to an existing system is not prohibitively high and the initial cost should be able to be amortised over a relatively short period of time. Depending on plant output, the resultant monthly savings could produce a reasonably good pay-back period.
- There are some cautions which need to be considered, particularly with regard to security of the supply, the increase in setting times and the decrease in early strength.

The following condensed information is acknowledged as being drawn from some overseas studies and is presented for general information. Together with your own further research, it could assist small plant owners who are looking for a bottom line improvement.

GBFS is slag from the iron production in Basic Oxygen Furnaces. When this slag is actively cooled and ground, GBFS is produced and can be utilised as a cement or concrete addition. GBFS is said to increase durability of concrete due to an increased setting time, which reduces the possibility of cracks. This increased setting time can however be problematic in some applications of concrete.

The main driver for utilising GBFS is Increased Quality:

Cements containing GBFS usually exhibit a lower early strength if ground to the same fineness and a lower heat of hydration. These cements often show higher long-term strength and particularly improved chemical resistance.

In the construction field, securing concrete with an early strength (on the first and third day of aging) is a particularly crucial factor that determines the time of removal of the forms (or the shortening of the construction time period)

The main barriers for utilising GBFS are Standards and regulations:

Cement with GBFS has a different standard than cement without GBFS. Technical performance of concrete produced with cements containing GBFS is different. GBFS can have a higher strength and durability, but the setting time is typically longer which makes them not suitable for all applications, which are regulated by standards. According to these standards, cement containing GBFS cannot replace Portland on a one-tonne basis.

An Early Strength Accelerator developed by using an industrial by-product and industrial waste could be used to supply SO_3 and apply alkaline-activation to improve the compressive strength at the mortar level, as a way of improving the early strength of GBFS-mixed concrete, which usually has the problem of a low early-strength.

Fly Ash is a by-product of the coal-fired power industry and it can be used in pre-cast and in ready-mix concrete (also known as a Type II addition). The characteristics, quality and application methodologies of the end product can differ based on the quality of the FA, the ratio of FA used and the production process. Fly Ash is said to increase the strength and durability of concrete, making for a good cement addition. It also makes economic sense, as it is a cheaper material to use than clinker. The main application of FA is as an addition in cement and concrete production

The main drivers for utilising Fly Ash are:

Increased Quality: FA in concrete contributes to the properties of the hardness of concrete through hydraulic and pozzolanic activity. This is the main driver today

Reduction of costs: As substitute for clinker and as replacement of cement FA reduces the costs of cement since FA is on average less expensive than clinker and cement. According to the stakeholders interviewed, the use of FA can reduce the amount of clinker per tonne of cement from 850 kg to 600 kg.

The main barriers for utilising Fly Ash are:

Uncertain availability on short term and long term: There is often over capacity of FA in the winter and under capacity in the summer; therefore, sourcing a consistent supply can sometimes be difficult.

Reduced reactivity: FA is subject to agglomeration if stored outside, which affects its fineness and furthermore reduces its reactivity. This reactivity is essential for the cement process and therefore materials like lime are added to compensate for the reduction in reactivity.

Need for dry material: The problem with using FA from stockpiles is that to be compatible with cement plant dry free flow material is needed, so the available wet FA needs to be dried.