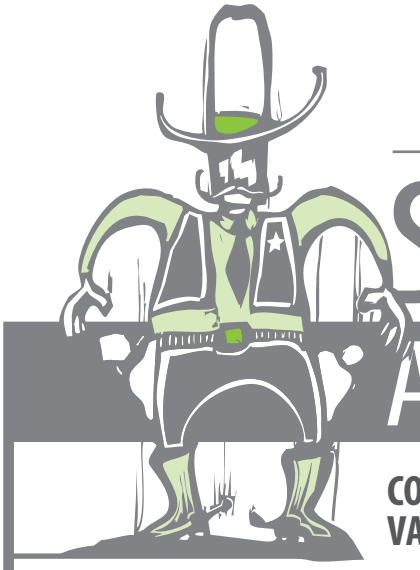

SCORE CARD:

ASR-STOMPING SCMs

	COST VALUE[1]	EASE OF USE/ PLACEMENT[2]	CONSISTENT MAKE-UP & PERFORMANCE[3]	CLEAN & GREEN[4]	PROVEN TO MITIGATE ASR[5]
ASR Miti•Gator™	■	■	■	■	■
Lithium Compounds		■			■
Fly Ash (Type F)	■	■			■
Metakaolin		■	■		■
Silica Fume	■				■
Blast Furnace Slag	■	■	■		■

1 • Priced near the cost of Portland cement; percent of replacement and concrete enhancement economically feasible for large-quantity use.

2 • Concrete placement and methods not adversely affected by inclusion of SCM

3 • Predictable, repeatable performance results per concrete mix design; consistent particle size distribution, density and chemical properties.

4 • Free of junk and hazardous contaminates; will not leach toxins into the soil; requires no energy-intensive calcination (heating)

5 • At least at some acceptable level of effectiveness.

ASR MITI•GATOR™

COST VALUE: priced at or below the cost of Portland cement; effective against ASR at 20% of cement replacement, no matter the reactivity level of aggregate; sustainable source. EASE OF USE/PLACEMENT: use of pumice as SCM increases water requirements; easily brought back into desired W/C ranges with water reducer admixture. CONSISTENT MAKE-UP & PERFORMANCE: quantifiable chemical make-up bag after bag; predictable performance in concrete mix design load after load; makes additional and significant contributions to concrete durability beyond mitigating ASR; compatible with most concrete admixtures. CLEAN AND GREEN: white pumice from a naturally pure deposit; contains no hazardous compounds, safe to use, no leachate concerns; naturally calcined; requires minimal processing to grade; consistent spec.

LITHIUM COMPOUNDS

COST VALUE: effective dosage levels depend on several factors, including compound type, which greatly complicates the prescription; Lithium nitrate (LiNO3) most commonly used for ASR suppression; typically used in combination with a stabilizing pozzolan. EASE OF USE/PLACEMENT: causes widely-variable effects on wet concrete characteristics, depending on compound type, other present admixtures, and cement types; research studies on concrete behavior produce contradictory data. CONSISTENT MAKE-UP & PERFORMANCE: extremely complex cause-and-effect relationships with other concrete materials: requires extensive testing to dial in correct dosage for a given project/application. CLEAN AND GREEN: Leachate concerns. PROVEN TO MITIGATE ASR: increasingly specified for constructs where de-icing chemicals are used, most often in conjunction with fly ash (the use of both provides better ASR mitigation than either alone).

CONTINUES

SCORE CARD: ASR-STOMPING SCMs

FLY ASH (TYPE F)

COST VALUE: waste product, historically inexpensive or free, but declining availability of Type F causing price fluctuations and sourcing problems. EASE OF USE/PLACEMENT: been in wide use for decades so well understood; some fly ash decreases water need, some increases it; generally improves workability of concrete. CONSISTENT MAKE-UP & PERFORMANCE: different coal sources produce different ash chemistry and contaminant concentrations, as do evolving ash filtration requirements; particle sizes vary greatly; on-going testing necessary to ensure desired performance; fly ash color can be anywhere from light grey to dark brown; makes additional and significant contributions to concrete durability beyond mitigating ASR. CLEAN AND GREEN: as a waste product (scrubbed from coal-burning furnace smoke) fly ash is loaded with hazardous chemistry and other junk particulates; heavy metal leachate concerns; use in concrete reduces amount of fly ash that must be landfilled or stored in ash ponds. PROVEN TO MITIGATE ASR: not as effective as some other pozzolans—fly ash mix designs often require an additional SCM to achieve acceptable ASR mitigation levels.

METAKAOLIN

COST VALUE: made from heating (calcining) high-purity kaolin clay to create amorphous aluminosilicate—production costs dictate limited/specialized project usage; effective against ASR at 10 to 15% of replacement, depending on reactivity level of aggregate. EASE OF USE/PLACEMENT: variable effect on water demand depending on grade; smooth, creamy finishability; generally improves workability of concrete. CONSISTENT MAKE-UP & PERFORMANCE: consistent white color; carefully controlled selection and firing processes equal predictable chemical make-up; makes additional and significant contributions to concrete durability beyond mitigating ASR; compatible with most concrete admixtures. CLEAN AND GREEN: modern flash-heating processes avoid introducing impurities; manufacture requires calcining (heat-induced transformation).

SILICA FUME

COST VALUE: waste furnace product, price can vary from half to twice the cost of Portland cement. EASE OF USE/PLACEMENT: extreme fineness of particles increases water demand, use of water reducer admixture necessary; extreme fineness creates handling problems and is typically densified or slurried for transport; can contribute to stickiness and reduce concrete workability. CONSISTENT MAKE-UP & PERFORMANCE: Chemical composition varies according to the type of alloy or metal being produced; prone to clumping, which causes it to act more like a fine reactive aggregate and contribute to ASR formation and so extensive mixing necessary to facilitate proper dispersion; can be used with superplasticizers to design ultra-high-strength concrete. CLEAN AND GREEN: waste byproduct filtered from quartz+coal furnace exhaust gases; use in concrete reduces amount of fume that must be landfilled.

GROUND GRANULATED BLAST FURNACE SLAG

COST VALUE: grade-variable cost. EASE OF USE/PLACEMENT: can decrease concrete water demand; generally improves workability of concrete. CONSISTENT MAKE-UP & PERFORMANCE: uniform composition from source to source; generally improves concrete finishability; lightens concrete color; makes additional and significant contributions to concrete durability beyond mitigating ASR. CLEAN AND GREEN: made from rapidly chilled iron blast-furnace slag; contains metal impurities.

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