POTASH

http://www.arabpotash.com/Pages/viewpage.aspx?pageID=29

What is Potash?

- Potash refers to any of various salts that contain potassium (symbol K in the periodic table of elements) in water-soluble form.

- The most common potassium-bearing salt in nature is potassium chloride (KCl).

Where does the name come from?

- The term 'potash' is derived from 'pot ash', after the old method of extracting potassium carbonate (K_2CO_3), which consisted of leaching wood ashes and evaporating the resulting solution, leaving a white residue called 'pot ash'.

How does potash occur in nature?

- Potassium is the seventh most common element on earth, which can be found in heavy soils and sea water, which typically contains 390 mg/l K.
- Large potash bearing rock deposits occur in many regions of the world deriving from the minerals in ancient seas which dried up millions of years ago.
- Potash is mined from these deposits in most potash producing countries.
- The Dead Sea is also a natural reservoir of many minerals, including potash, which is found in high enough concentrations for commercial production.

What is it used for?

- More than 90% of potash produced in the world is used for fertilizers.

- It normally requires simple separation from salt and other minerals and physical grading into a form suitable for fertilizer manufacture or farm spreading.

Why do we need potash?

- Potassium is one of the three principal components of fertilizers, which are labeled by their N-P-K content (nitrogen, phosphorous and potassium).

- potassium raises yields and food value, builds disease resistance, and it improves shipping, handling and storage qualities of crops.

- An adult human requires around 2 grams/day of potassium and typical intakes are 2.8 - 4.5 grams/day, from milk and dairy products, fruit juices, root vegetables, and bananas which are a rich source of potassium. Potassium consumption is part of a healthy diet.

Potash Production Process

Arab Potash Company (APC) has the capacity to produce an approximate total of 2.35 million tons per year of potash via its four plants in Jordan:

- The Hot Leach Plant (HLP).
- The Cold Crystallization Plant (CCP I).
- The Industrial Potash Plant (IPP).
- The New Cold Crystallization Plant (CCP II).

Operations

- The site of Arab Potash Company (**APC**) is located 110 kilometers south of Amman and 200 kilometers north of Aqaba.
- The site is basically a Solar Evaporation Ponds System of an area of 112 km^2 and processing plants.
- APC produces four grades of potash: standard, fine, granular and industrial grade potash .

Potash Production Process

- Dead Sea brine is pumped to solar ponds at the Dead Sea Pumping Station, and an initial concentration process is developed.

- The solids formed in the brine precipitate to form salts in the ponds.

Operations

- Solar Ponds: The process starts at the Brine Intake pumping station where four intake pumps with a capacity of approximately 20 m^3 per second deliver 250 - 300 million tons per year of Dead Sea water.
- The precipitated raw material for producing potash is precipitated as mixture of Carnallite ($KCl.MgCl_2.6H_2O$) and NaCl.
- This bed is harvested as a slurry from beneath the brine and delivered to booster pumps on the dikes and then to the refinery through floating pipes.

Operations

Floating pipes

Operations

Carnallite harvester

Processing Plants

Processing Plants

1. The Hot Leach Plant

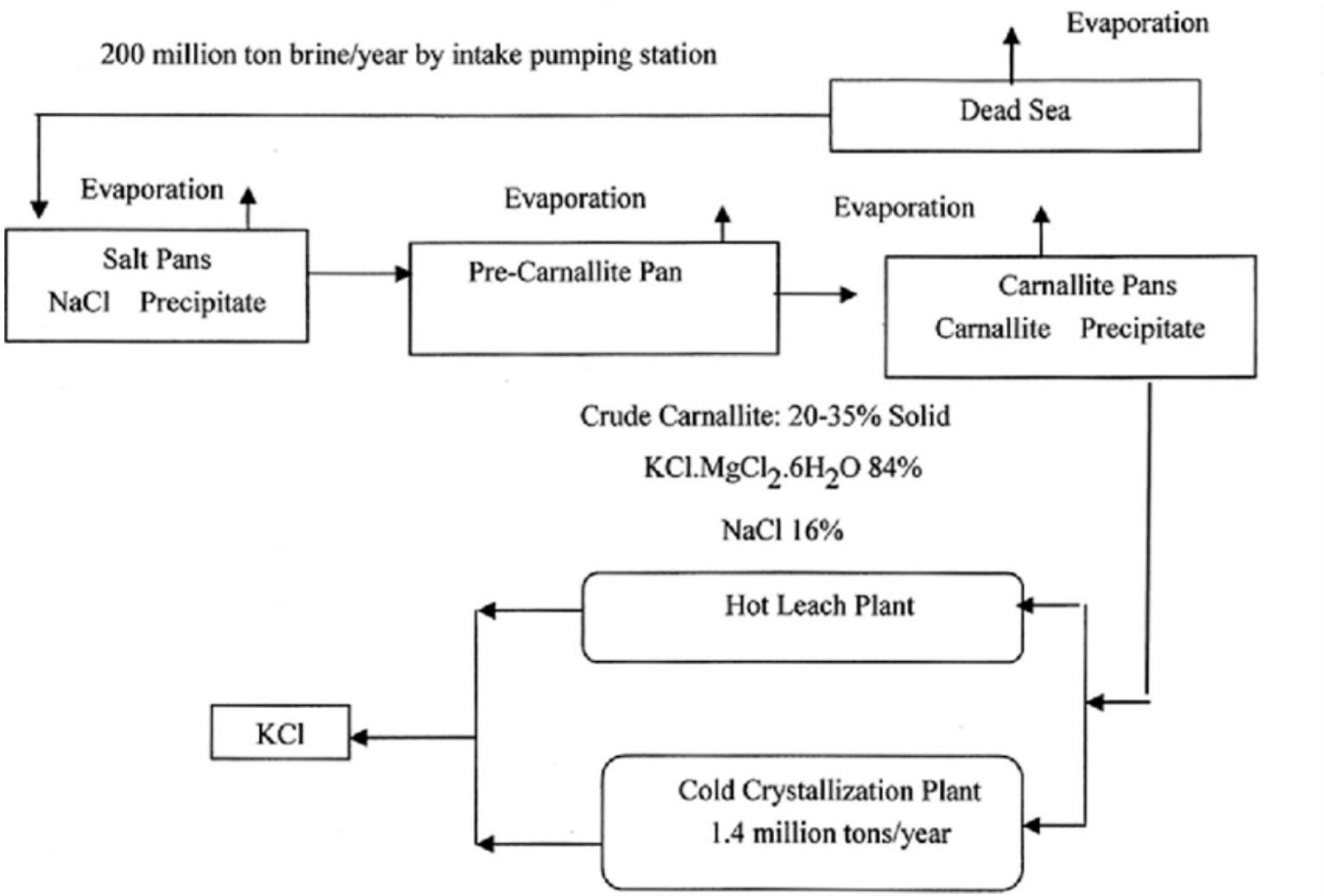
APC utilizes the hot leach process technology to produce high grade standard and fine potash, which includes the following units of operation:

- Carnallite Processing;
- Sylvinite Processing;
- Crystallization;
- Product Dewatering;
- Drying;
- Screening.

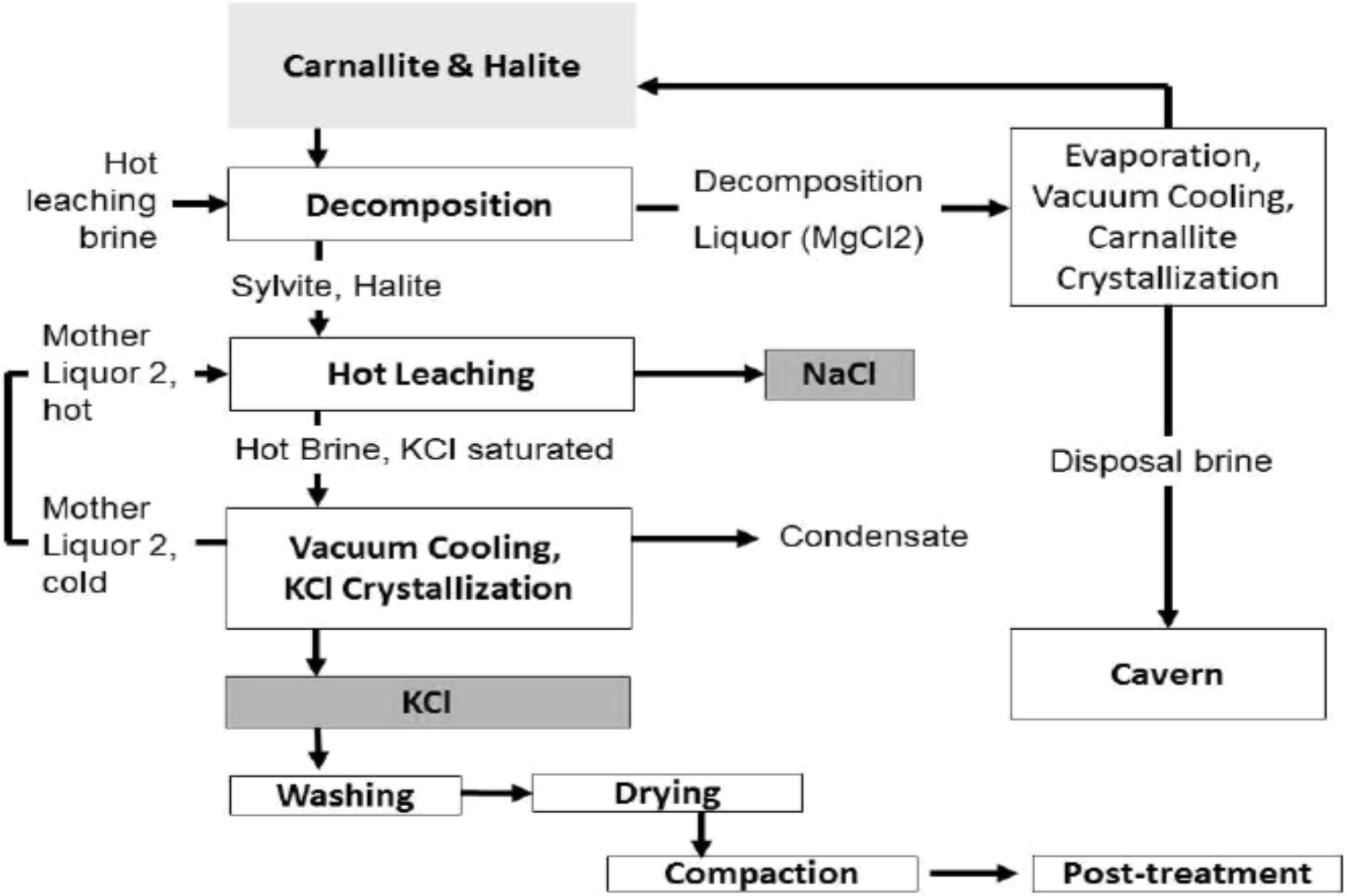
Carnallite ($KCl.MgCl_2.6H_2O$)

Sylvinite : KCl+ NaCl

The Hot Leach Process



The Hot Leach Process



Hot Leaching Process

- A process first used in 1860 for the extraction of potash from sylvinite ore based on the differing solubilities of sodium and potassium chloride.
- The ore, which is a mixture of sodium and potassium chloride, is crushed and mixed with saturated sodium chloride.
- It is heated to boiling in which the potassium chloride dissolves but the sodium chloride does not.
- On cooling, the potassium chloride crystallizes and is separated.
- The key to success in the HLP process to increase efficiency is ensuring the brine feed to crystallizers is always saturated, thus increasing their KCl content and thus crystallizers are operated at their optimum, with the proper control of brine temperature. This will both increase production and reduce the current specific steam consumption numbers.

Plant Processing/ Hot Leach Plant

Carnallite Processing

- Carnallite ($KCl.MgCl_2.6H_2O$) slurry is received,
- Dewatered and decomposed with water.

- The resulting solids mixture (Sylvinite: KCl+ NaCl) is dewatered and washed, creating a cake-like material.

Plant Processing/ Hot Leach Plant

Sylvinite Processing

- Sylvinite cake is leached. Heated brine returned from the crystallization stage is used for leaching the potassium chloride (KCl) solids.
- The hot KCl-saturated brine is clarified in a thickener, and then the overflow is pumped to the crystallization stage.
- The underflow slurry containing sodium chloride crystals is dewatered, repulped with waste brine and pumped to tailings.

Plant Processing/ Hot Leach Plant

Crystallization

- Hot brine is cooled successively in a six-stage vacuum crystallizer system.
- Upon cooling, the KCl decreases in solubility and crystallizes under controlled conditions.

Plant Processing/ Hot Leach Plant

- **Product Dewatering** – Potash slurry from the crystallization stage is dewatered using hydro-cyclones and centrifuges.

- **Drying** – Cake from the centrifuges is conveyed to the rotary dryer to remove the last traces of moisture entrained with the crystals. The product is then sent to the screening unit, while the dust is collected using high-efficiency cyclones.

Plant Processing/ Hot Leach Plant

- **Screening** – The product is segregated into standard and fine grades, and an anti-caking agent is added to both products in controlled amounts to minimize potash's natural tendency to agglomerate during storage and shipment.

- **De-dusting Systems** – Specially installed systems, such as bag filtration units and high-efficiency cyclones minimize environmental impact and potash losses as dust.

Plant Processing/ Industrial Potash Plant

2. Industrial Potash Plant:

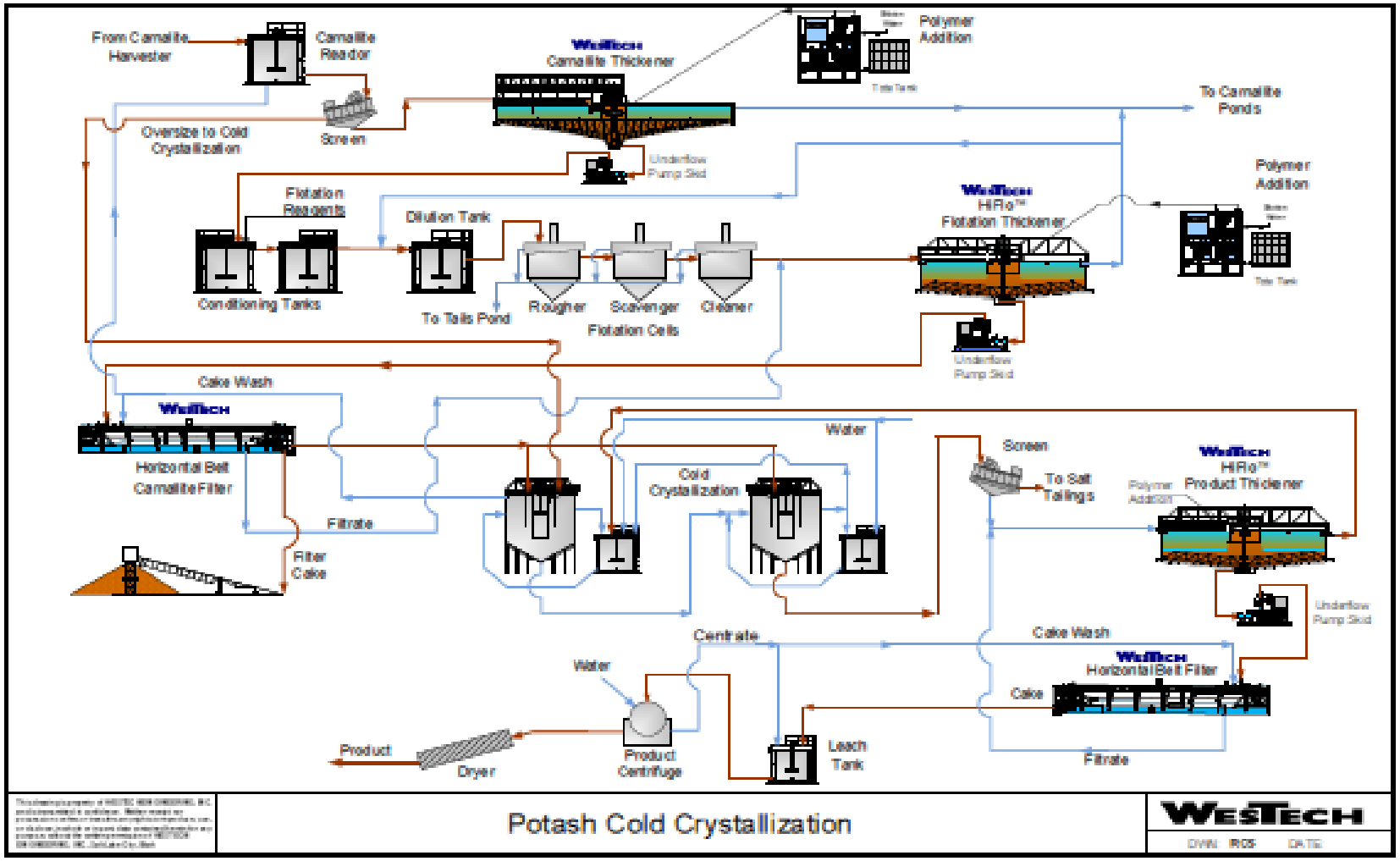
Industrial grade Potash (KCl) is the premium form of Potassium Chloride (99.2% KCl min.) that is produced to meet the needs of the non-fertilizer sector.

Plant Processing/Cold Crystallization Plant

Cold Crystallization Plant I:

- The cold crystallization plant is independent of the hot leach facility.
- It is operated under ambient temperature and therefore requires less energy.
- It includes the following processes: Carnallite Receiving; Flotation; Crystallization; Cold Leaching; Drying.

Cold Crystallization Process



Plant Processing/Cold Crystallization Plant

Carnallite Receiving

- Crude carnallite slurry is first beneficiated by wet screening to separate the high-grade carnallite fraction, which is about one quarter of the solids.
- This high-grade carnallite (coarse carnallite) is fed directly to the cold crystallizers.
- The screen undersize slurry is mixed with brine discharge from the cold crystallizers overflow, which is at or near saturation, in a draft tube reactor.

Plant Processing/Cold Crystallization Plant

Carnallite Receiving

- When solar pond brine mixes with crystallizer brine in the reactor, precipitation of carnallite occurs as the brine mixture equilibrates.
- Slurry from the reactor is densified in the carnallite thickener and the overflow is returned to the evaporation ponds.

Plant Processing/Cold Crystallization Plant

Flotation

- Carnallite thickener underflow is beneficiated by a flotation technique, in which sodium chloride is floated and pumped to the tailings area.
- Sink slurry is settled in a flotation thickener, the overflow of which is used as make-up brine to the flotation cells and the excess is pumped to the carnallite thickener.
- Flotation thickener underflow is dewatered in centrifuges.

- Centrifuge cake (fine carnallite) is conveyed to the cold crystallizers and the effluent is recycled to the flotation thickener.

Plant Processing/Cold Crystallization Plant

Crystallization

- Coarse carnallite and fine carnallite are decomposed in a two-stage crystallizer system in the presence of water. Potassium chloride crystals are formed in the crystallizers.
- Crystallizer discharge slurry is wet screened to remove large particles of carnallite and/or sodium chloride.
- Screen oversize is pumped to the tailings area along with flotation overflow slurry. Screen undersize is directed to the leaching area.

Plant Processing/Cold Crystallization Plant

- **Cold Leaching**
  In order to remove adhering high magnesium chloride brine from the crystallizer product, two-stage leaching and dewatering centrifuges are used to reduce the magnesium chloride content in the product down to the allowable limit.
- **Drying**
  Second-stage centrifuge cake is dried to 0.1% moisture content in a co-current, rotary dryer. The product is then cooled in a rotary cooler by a counter-current air stream.

Plant Processing/Cold Crystallization Plant

Cold Crystallization Plant II

- A second Cold Crystallization Plant (II) came into service in late 2010 to give a total production of 450,000 tpy. The new plant is similar to the Cold Crystallization Plant I, but it has certain modified processes and more advanced technology, mainly in crystallization, flotation, screening, leaching and other areas, and an advanced control system (DCS) was incorporated to facilitate control of various processes. Highly efficient dust collection systems were included in the new plant to ensure minimum dust emissions into the surrounding environment, and a new compaction plant was also installed to produce more than 260,000 tpy of high quality granular potash. The new compaction plant comprises a post-treatment unit intended for enhancing the quality of granular potash.
- https://alchetron.com/Arab-Potash

Quality control

- **Standard/ fine grade**

CHEMICAL			
Chemical Composition	**Units**	**Standard**	**Fine**
Potassium Oxide, as K_2O (min)	%	61.00	62.00
Potassium Chloride, KCl (min)	%	96.50	98.00
Sodium Chloride, as NaCl (max)	%	2.60	1.00
Magnesium Chloride, $MgCl_2$ (max)	%	0.50	0.50
Calcium Chloride, $CaCl_2$ (max)	%	0.06	0.05
Moisture, as H_2O (max)	%	0.35	0.35
Anti-Caking / Amine	-	Added	Added

Quality control

PHYSICAL			
Tyler Mesh Typical Percentage Retained			
Tyler Mesh	**Opening (mm)**	**Standard**	**Fine**
+10	1.70	1 - 3	
+14	1.18	8 - 15	
+20	0.85	20 - 40	
+28	0.60	40 - 60	0 - 4
+35	0.425	65 - 85	7 - 12
+48	0.30	88 - 95	20 - 40
+65	0.212	93 - 99	45 - 65
+100	0.150		75 - 85
+150	0.106		80 - 90
Guaranteed (Tyler Mesh) [mm]		**90% min. between (10-65) [1.70-0.212]**	**70% min. between (35-150) [0.425-0.106]**

PHYSICAL PROPERTIES		
	Standard	**Fine**
Stowage Factor	36	34
Bulk Density (MT/m^3)	1.299 - 1.358	1.174 - 1.331
Angle of Repose (Degrees)	28.5 - 29.5	29 - 30

Quality control

- **Stowage factor,** In shipping indicates how many cubic meters of space one metric tonne of a particular type of cargo occupies in a hold of a cargo ship.

- **Bulk density** is the mass of bulk solid that occupies a unit volume of a bed, including the volume of all inter-particles voids

Quality control

- **Angle of response:**

  Steepest **angle** of descent or dip relative to the horizontal plane to which a material can be piled without slumping.

زاوية الانحدار أو
الانحدار النسبي

Environmental impact

- Waste reduction and recycling, environmental protection including prevention of contamination, dust emissions reduction, and improvement of operational efficiency mainly using Natural Gas in production to reduce gases emissions.
- APC has applied Environmental Management System since 2001; where recently it is updated version of ISO 14001:2015.