

USING X-RAY SORTERS TO PRE-CONCENTRATE ROM PHOSPHATE ORE

HAROLD CLINE, TOMRA SORTING SOLUTIONS
A.J. DECENSO, PREFERRED PROCESS SOLUTIONS

ABOUT TOMRA SORTING SOLUTIONS

**TOMRA
creates
sensor-based
solutions for
optimal
resource
productivity**



Obtaining



Using



Reusing

ABOUT PREFERRED PROCESS SOLUTIONS, LLC



Screening



Sorting



Air Classifying



Milling



Preferred
Process Solutions



Centrifuging



Drying

ecutec[®]



Coating



Plant Design



XRT SORTING OF PHOSPHATES

Feed Material Phosphates with Chert (Si) contaminants



Objective Remove as much chert as possible before the process of milling and flotation

XRT SORTING OF PHOSPHATES

Sorted Product Phosphates



Sorted Waste Material Chert (Si) contaminants



Although it looks like a simple color separation, much of the chert is covered by white phosphate

XRT SORTING OF PHOSPHATES



Apatite
 $\text{Ca}_5[(\text{PO}_4)_3(\text{OH},\text{F},\text{Cl})]$



Chert
 SiO_2

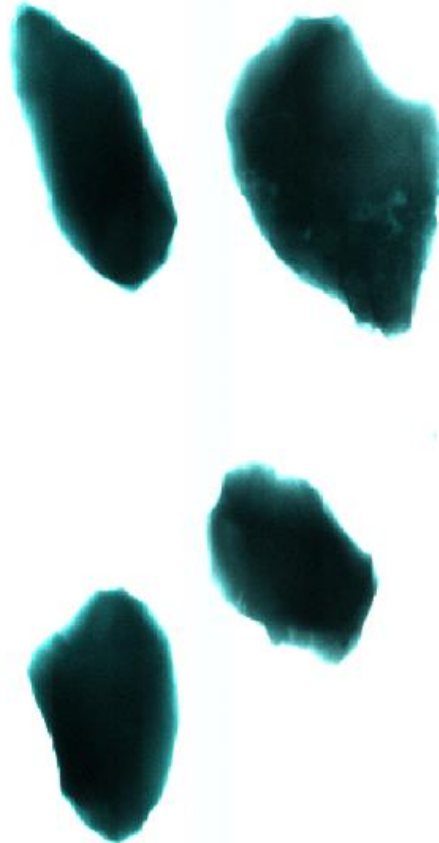
hydrogen 1 H 1.0079																				helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122										boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180				
sodium 11 Na 22.990	magnesium 12 Mg 24.305										aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948				
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80			
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29			
caesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]		
francium 87 Fr [223]	radium 88 Ra [226]	actinium 89-102 * *	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	ununbium 112 Uub [277]	ununquadium 114 Uuq [289]							

XRT IMAGE ACQUISITION AND PROCESSING

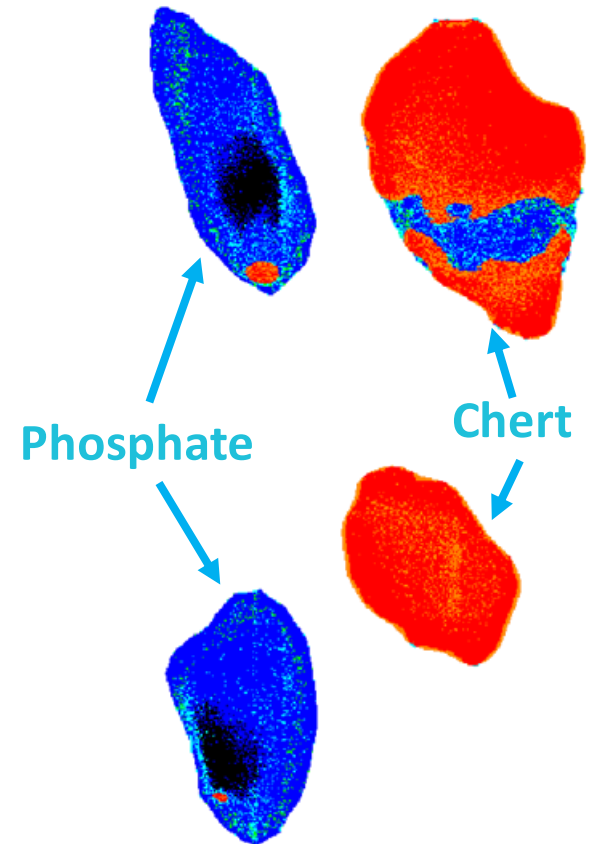
Visible Image



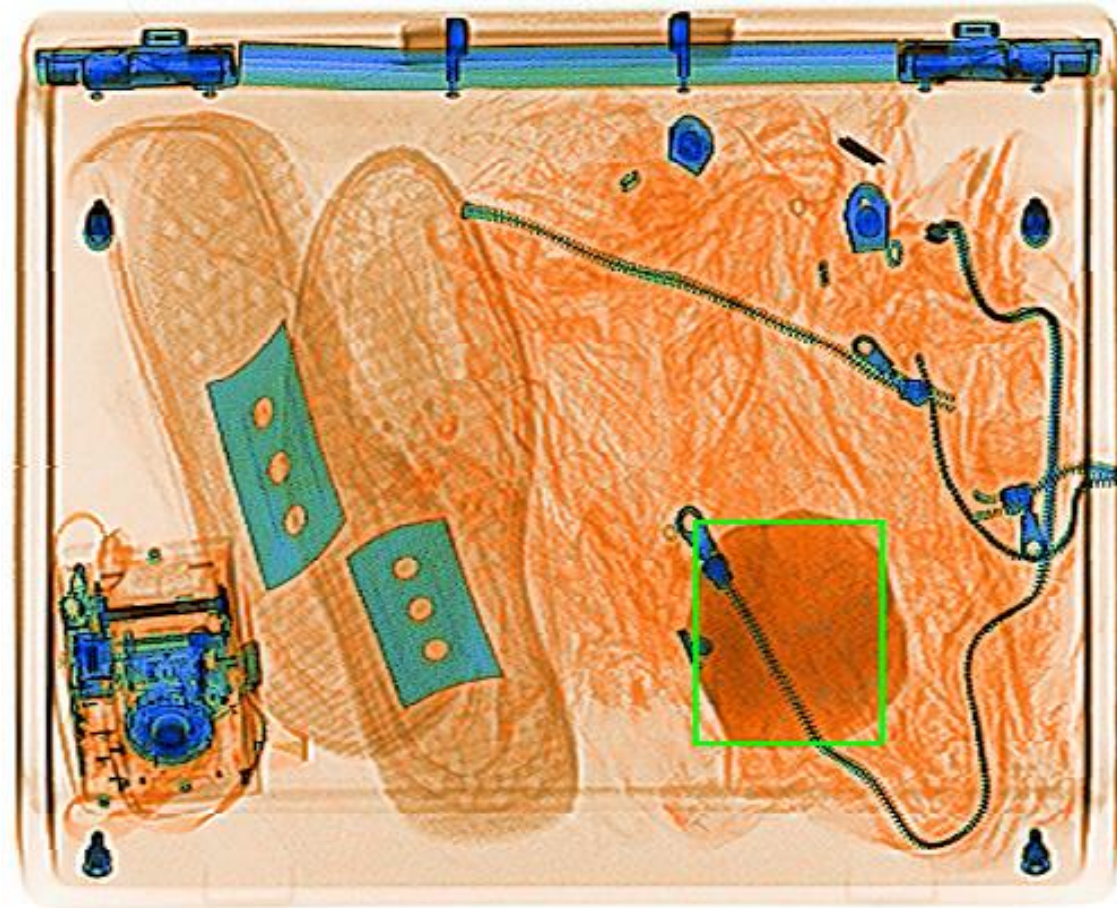
Raw XRT Image



Processed XRT Image



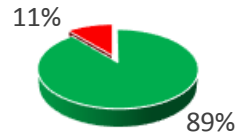
XRAY-TRANSMISSION



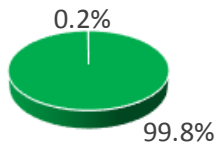
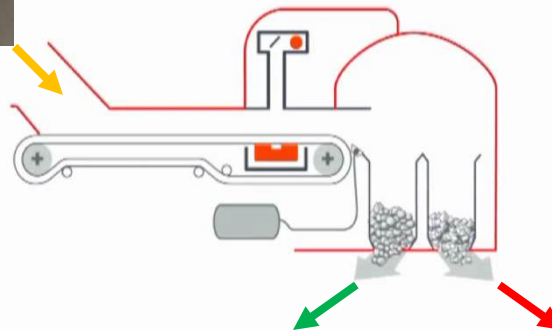
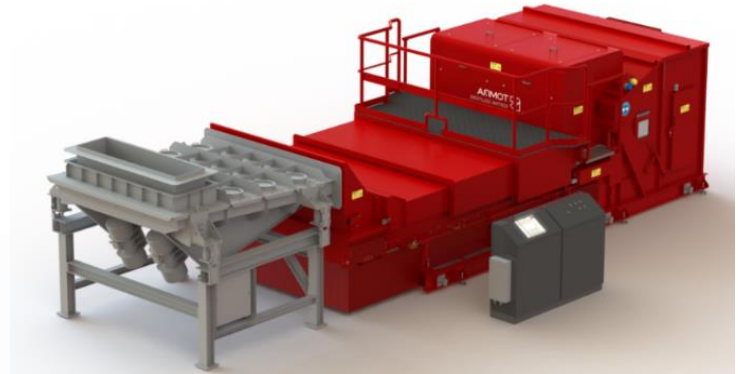
...what are a few suitcases per minute compared to 50 000 rocks per second?

TYPICAL RESULTS OF XRT SORTING OF PHOSPHATE

Feed – 250 t/h



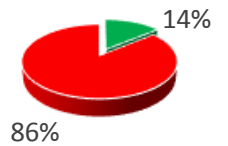
■ Phosphate
■ Silica



■ Phosphate
■ Silica



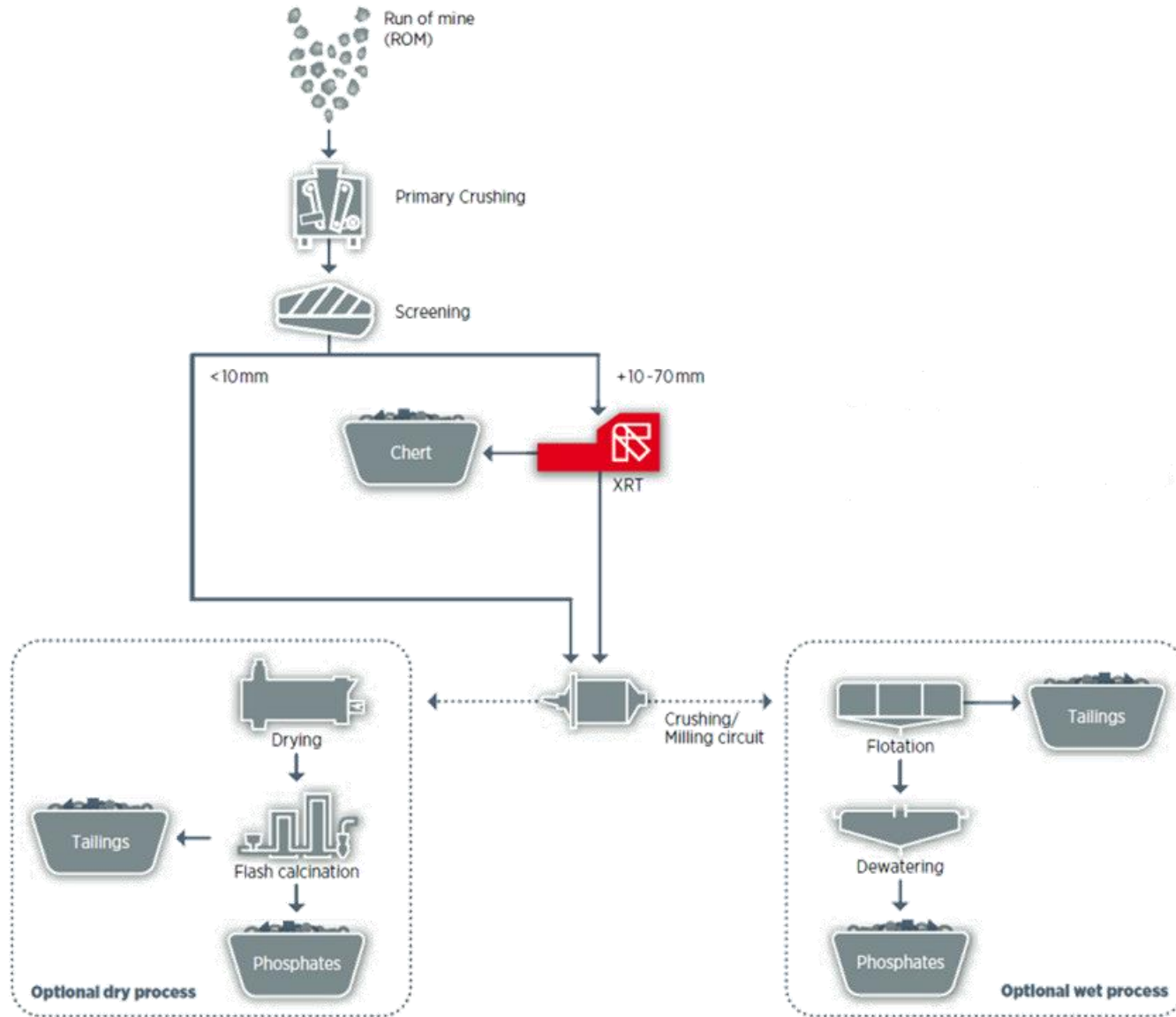
Accepts – 219 t/h



■ Phosphate
■ Silica

Rejects – 31 t/h

SIMPLIFIED PLANT FLOW SHEET



CONTAINERIZED SEMI-MOBILE DESTONING

Total plant capacity: 250 t/h

Bypass: <40mm @ 150 t/h

XRT sorting: 100mm x 40mm @ 100 t/h

Machines: Qty 1, COM XRT 1200

Features: ✓ small footprint

✓ no water needed

✓ easy licensing

✓ fast production ramp up

✓ savings in transportation

✓ easy waste disposal



HIGH CAPACITY STATIONARY INSTALLATION

Total plant capacity: 2,000 t/h

Bypass: <20mm @ 700 t/h

XRT sorting: 100mm x 20mm @ 1,300 t/h

Machines: Qty 9, COM XRT 2400 (+1 spare)

Features: ✓ no water needed

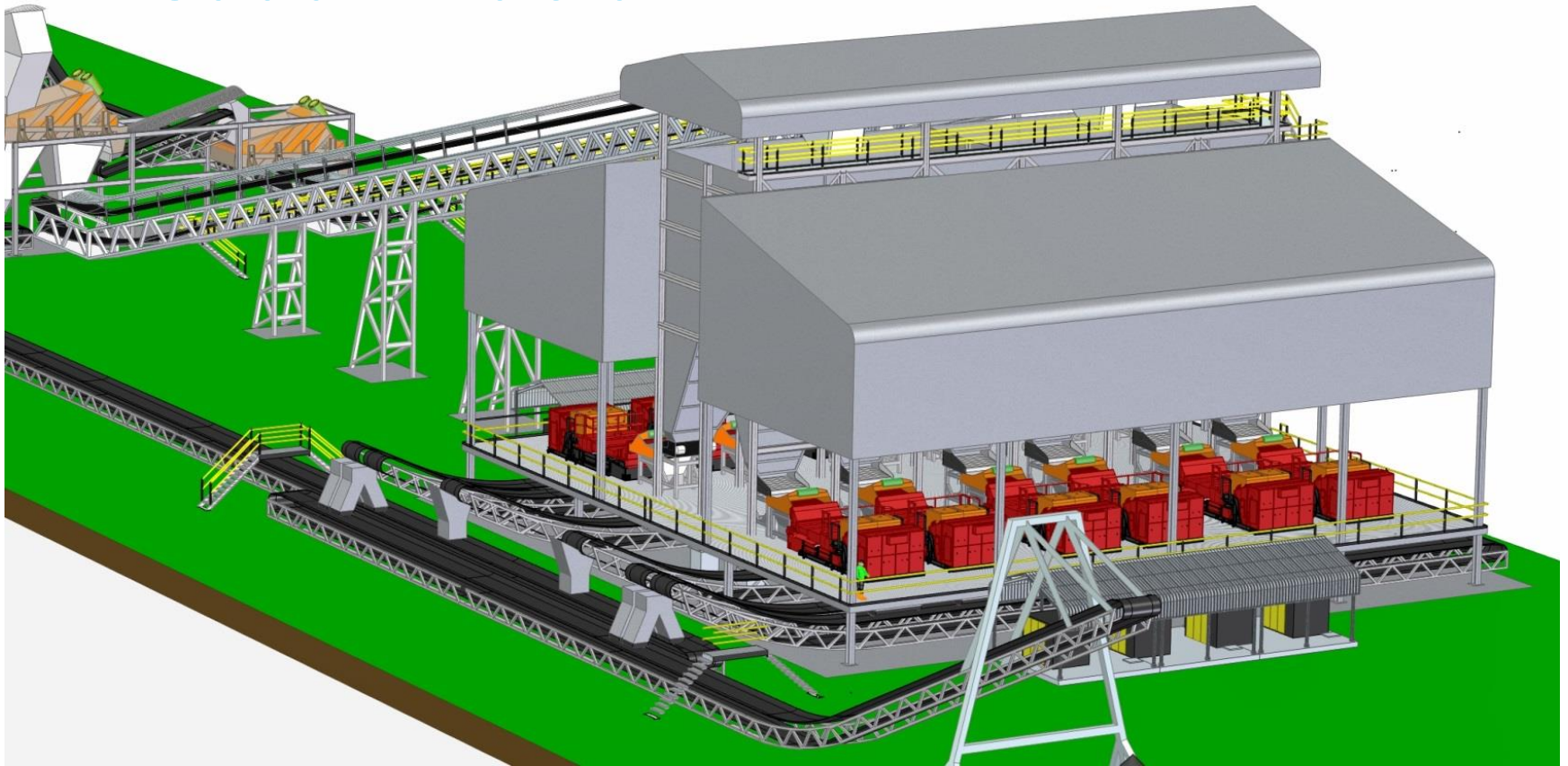
✓ easy licensing

✓ fast production ramp up



HIGH CAPACITY STATIONARY INSTALLATION

Ma'aden Phosphate *Saudi Arabia*



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