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Salt? Sold Out!

Review of Salt Supply Developments in Asia-Pacific Region

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13th Asian Chloralkali Conference, Kuala Lumpur, 26.6.2009

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February 2009: Flight over Australian Saltfields

GOOGLE EARTH

On 2. and 3.2.2009, Salt Partners flew over some of the world largest solar saltfields. Isabella Sedivy was shooting pictures.

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Shark Bay Salt Stockpiles

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At Shark Bay, the stockpiles are 200m long and 60m wide. Their design capacity is 250’000 t. They were less than half full.

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Lake McLeod Salt Stockpile

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At Lake McLeod, the stockpile next to the wash plant has a design capacity of 1’500’000 t. It was about 12% full.

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Lake McLeod Shipping Stockpile

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The Lake McLeod shipping stockpile is designed for up to 270’000 t. The heap was holding about 7’000 t.

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Onslow Salt Stockpile

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Onslow stockpile was designed for 500‘000 t of salt. On 2.2.2009, there was virtually no salt left. The picture shows the last salt shipment from Onslow in February 2009.

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Onslow Crystallisers

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The Onslow saltworks were flooded. Salt in one crystalliser was visible and was being harvested. Other crystallisers were inundated.

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Onslow Brine Ponds

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Onslow brine pond one week after it was hit by cyclone Dominic. Dykes were broken at three locations. Brine was flowing out, to the sea. It will take several months to restore full production.

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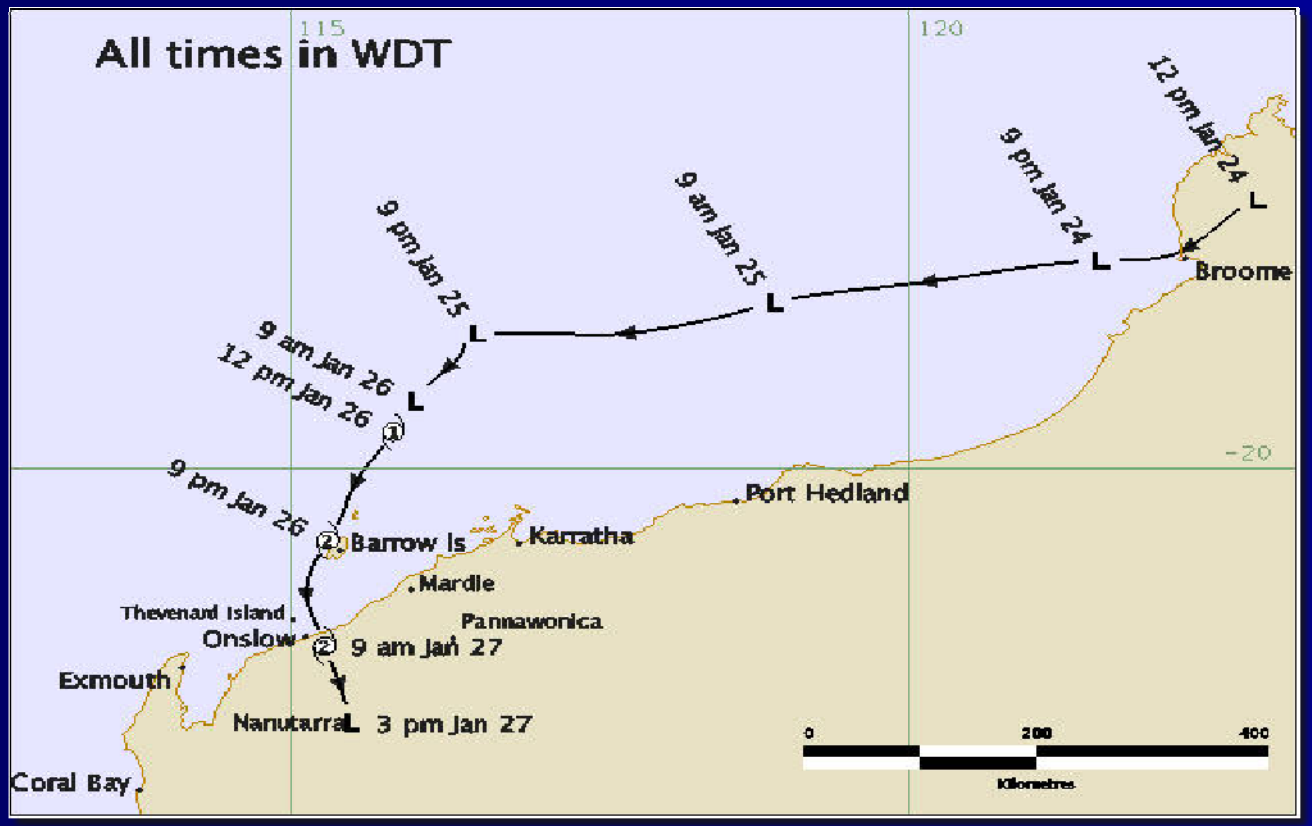
Tropical Cyclone Dominic



Australian Bureau of Meteorology

The Onslow saltfield was hit by tropical cyclone Dominic on 27.1.2009. Dominic was moderate category 2 cyclone with wind gust 140 km/h and 240 mm rainfall.

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Dampier Original Drying Stockpile

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At Dampier, the original drying stockpile was designed for up to 2’000’000 t. It is not being used any more. Harvested salt is hauled to the new washing plant near the sea shore.

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Dampier Original Intermediate Stockpile

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The two Dampier original intermediate stockpiles are now used to dry the salt washed in a new washing plant. They are 400 m long and 55 m wide. They can hold up to 500’000 t. The pictured stock is estimated at about 170’000 t or 36% of design capacity.

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Dampier Shipping Stockpile

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Dampier shipping stockpile could hold more than 250’000 t. The picture shows less than100’000 t of salt ready for shipment.

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Port Headland Stockpiles

Port Headland stockpiles are large enough to hold about 1’400’000 t. In February 2009, they were almost 60% full.

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Australian Salt Stockpiles in February 2009

Salt Producer	Stockpile	Stockpile Capacity	Salt on Stock	Percent Full
		(t)	(t)	(%)
Shark Bay		275‘000	133‘000	48%
Onslow		652‘000	1‘000	0%
McLeod	Drying	1'520‘000	180‘000	12%
	Shipping	267‘000	7‘000	3%
Dampier	Drying	1'896‘000	0	0%
	Intermediate	475‘000	169‘000	36%
	Shipping	264‘000	96‘000	36%
Port Headland	Drying	999‘000	567‘000	57%
	Shipping	384‘000	199‘000	52%
Total		**6'732‘000**	**1'352'000**	**20%**

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Australian Salt Production Capacity and Design Stockpiling Capacity

Salt Producer	Production Capacity	Stockpiling Capacity	Percent
	(t/y)	(t)	(%)
Shark Bay	2’200’000	275’000	13%
Onslow	2’500’000	653’000	26%
McLeod	2’300’000	1’787’000	78%
Dampier	4’000’000	2’635’000	66%
Port Headland	3’500’000	1’384’000	40%
Total	**14’500’000**	**6’734’000**	**46%**

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Australian Salt Production Capacity and Salt on Stockpile

Salt Producer	Production Capacity	Salt on Stockpile	Percent
	(t/y)	(t)	(%)
Shark Bay	2’200’000	133’000	6%
Onslow	2’500’000	1’000	0%
McLeod	2’300’000	187’000	8%
Dampier	4’000’000	264’000	7%
Port Headland	3’500’000	765’000	2%
Total	**14’500’000**	**1’352’000**	**9%**

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Drip-off Belts

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Most Australian wash plants employ drip-off belts. This picture shows that at the end of such belt, the salt is still dripping wet.

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Salt Drying on Stockpiles

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Drip-dried salt is still wet when stockpiled. The brine flows slowly to the ground and out of the stockpile (see bottom left).

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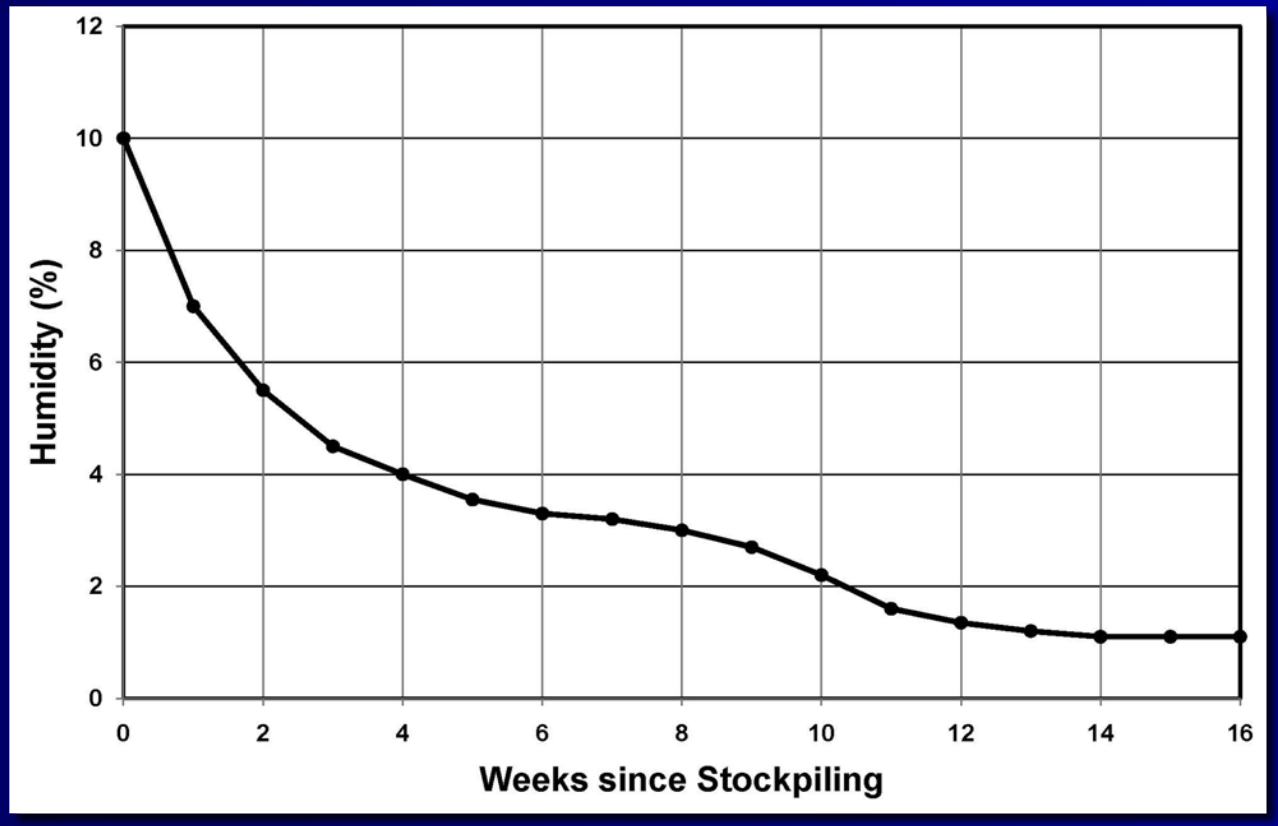
Salt on Stockpile, Humidity vs. Time



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Magnesium salts are hygroscopic. They absorb moisture from the air. The brine so formed dilutes the magnesium. As long as the salt is more than 3% humid, the brine flows with the magnesium out of the stockpile. After the magnesium is removed, the salt can dry up. The drying process takes about 3 months.

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Residual Magnesium in Salt after Washing

- **Magnesium in bitterns: 2.64%**
- **Magnesium in 10% humid salt after harvest: 0.26%**
- **Magnesium in sea water: 0.14%**
- **Standard magnesium content in salt: 0.02%**

Washing with sea water	Magnesium in 10% humid salt	Magnesium in 2.5% humid salt	Salt losses by dissolution
(l/t of salt)	(%)	(%)	(%)
100	**0.139**	**0.035**	**3**
200	**0.097**	**0.024**	**7**
300	**0.076**	**0.019**	**10**

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Consequences of Insufficient Salt Stock on Stockpile

- Insufficient reserve to overcome temporary production shortage
- Excessive humidity and magnesium, salt not up to specification
- Higher wash water consumption, thus excessive salt losses
- Reduced production rate

Insufficient Salt Stock is Undesirable

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Salt Production World-wide

Salt type	World production
Solar salt	100,000,000 t/y
Rock salt	80,000,000 t/y
Brines	80,000,000 t/y
Total	260,000,000 t/y

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Salt Consumption World-wide

Salt user	Salt consumption
Chemical industry	155,000,000 t/y
Food	45,000,000 t/y
De-icing	30,000,000 t/y
Other	30,000,000 t/y
Total	260,000,000 t/y

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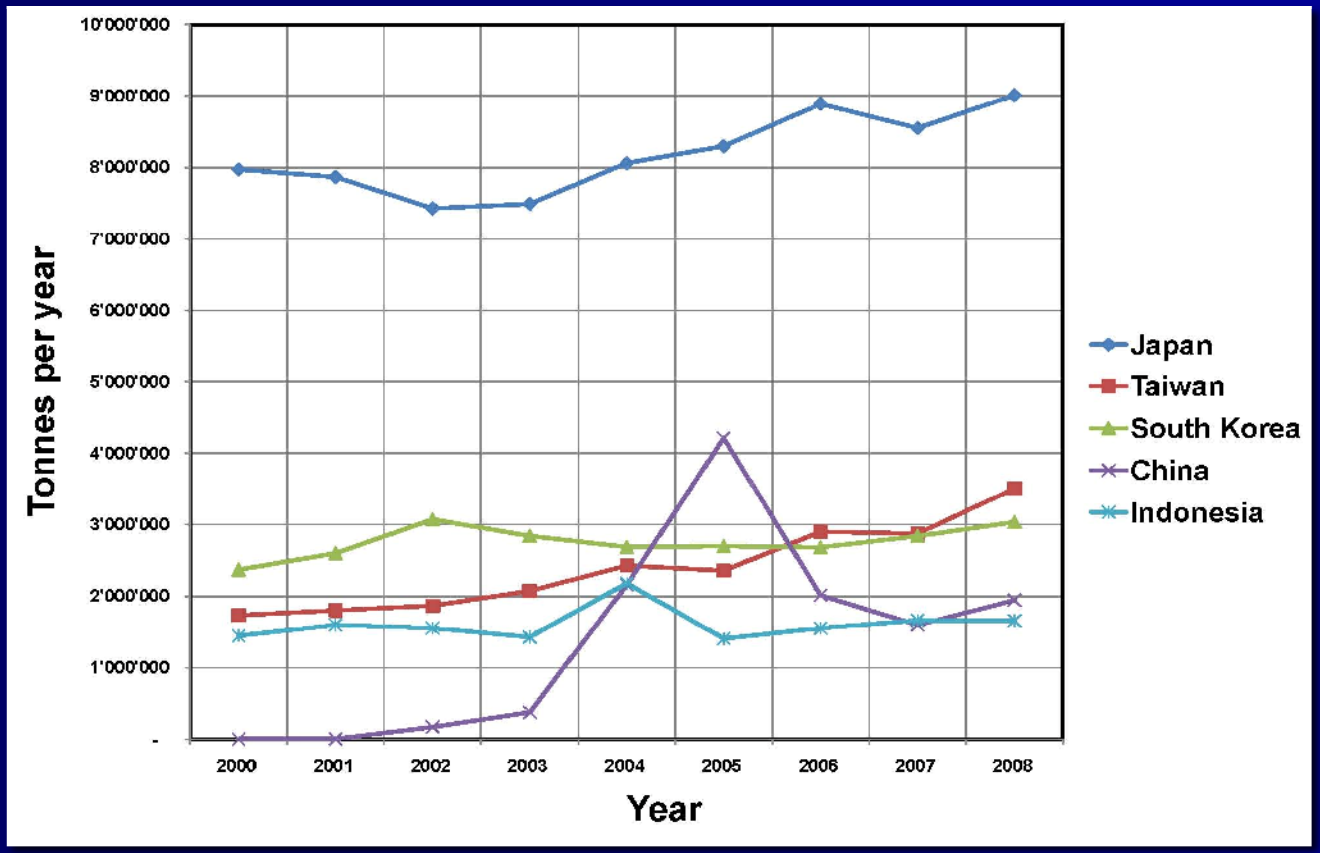
Largest Salt Imports in Asia-Pacific



Salt imports by the five largest salt importers in Asia Pacific region. Between 2000 and 2008, all countries have increased their salt imports.

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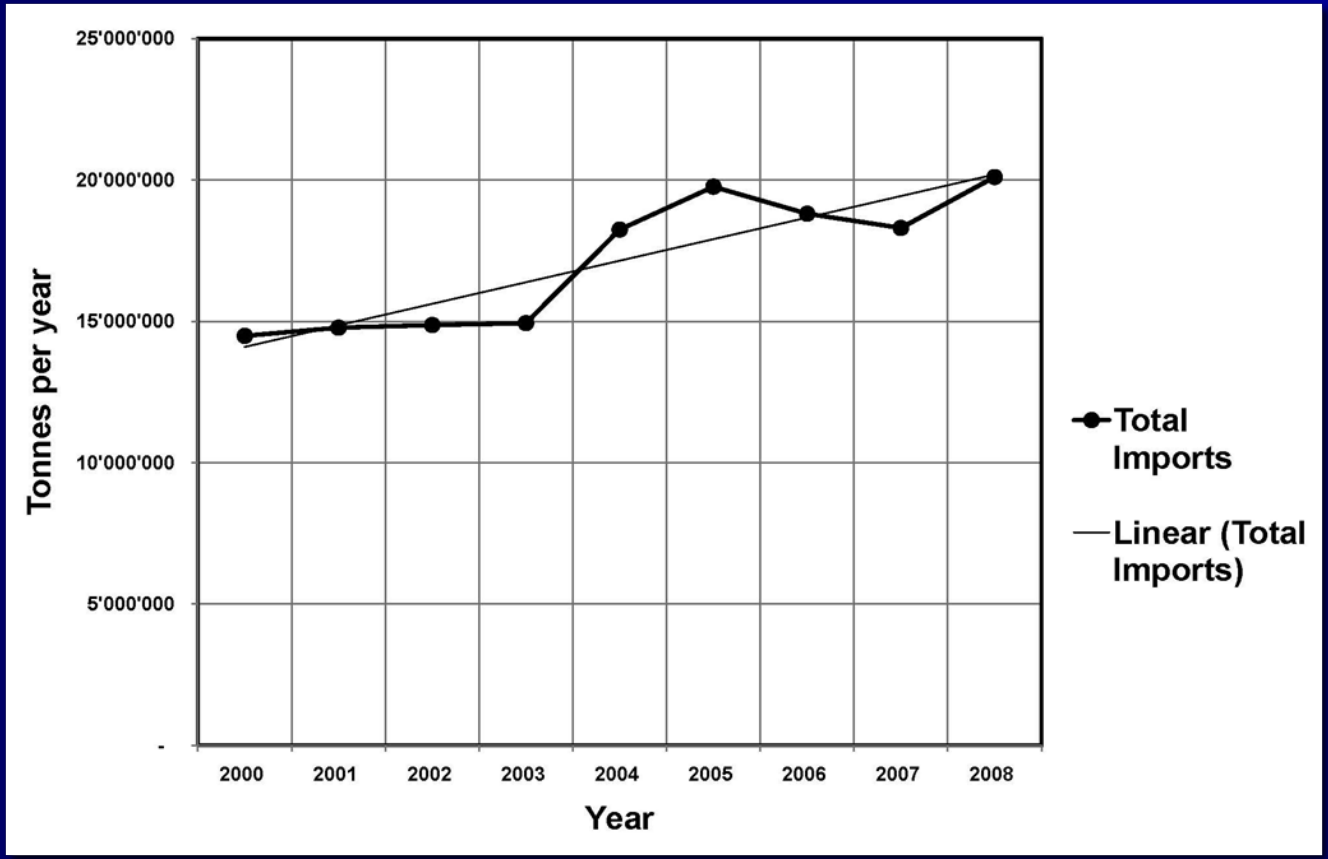
Total Salt Imports in Asia-Pacific



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In the eight years between 2000 and 2008, total salt imports in Asia Pacific region have risen by 6 million tonnes, equal to 40%, or equal to 4.3% per annum.

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Salt Supply Situation in other Regions

- Indian salt quality is not up to the “Australian standard”
- Due to shortage, Indian salt prices moved from INR 200/t to 700/t
- In the south of Africa, salt stockpiles are depleted
- Mexican salt production is at maximum and unlikely to expand
- Chilean salt has limited acceptance in the chloralkali industry
- Brazil is too far away from Asia-Pacific region

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Conclusion

Insufficient salt on stockpiles in Australia, together with signs of limited salt availability elsewhere, indicates that the present high quality solar salt production capacity is insufficient. The shortage is likely to accentuate when the present economic slowdown comes to an end and the high growth rates in the Asia-Pacific region are re-established.

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Remedy No.1:

Compensate shortage with poor quality salt

This option is undesirable:

- **Impurities increase the cost of brine treatment in chloralkali plants**
- **Poor quality salts cause excessive contaminated effluent discharge**

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General Cost of Salt and Impurity Removal

	Cost of brine treatment and sludge disposal	Cost of salt, brine treatment and sludge disposal
	(USD / t salt)	(USD / t salt)
Minimum	**1.50**	**10**
Average	**10**	**25**
Maximum	**30**	**50**

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Remedy No. 2

Compensate shortage with vacuum salt

This option is undesirable:

- **Vacuum salt is expensive**
- **Vacuum salt production is mostly energy inefficient**
- **1 ton of CO_2 per ton of salt may emanate when burning black coal**
- **Burning black coal frequently causes pollution**
- **CO_2 in the atmosphere causes global warming and climatic change**

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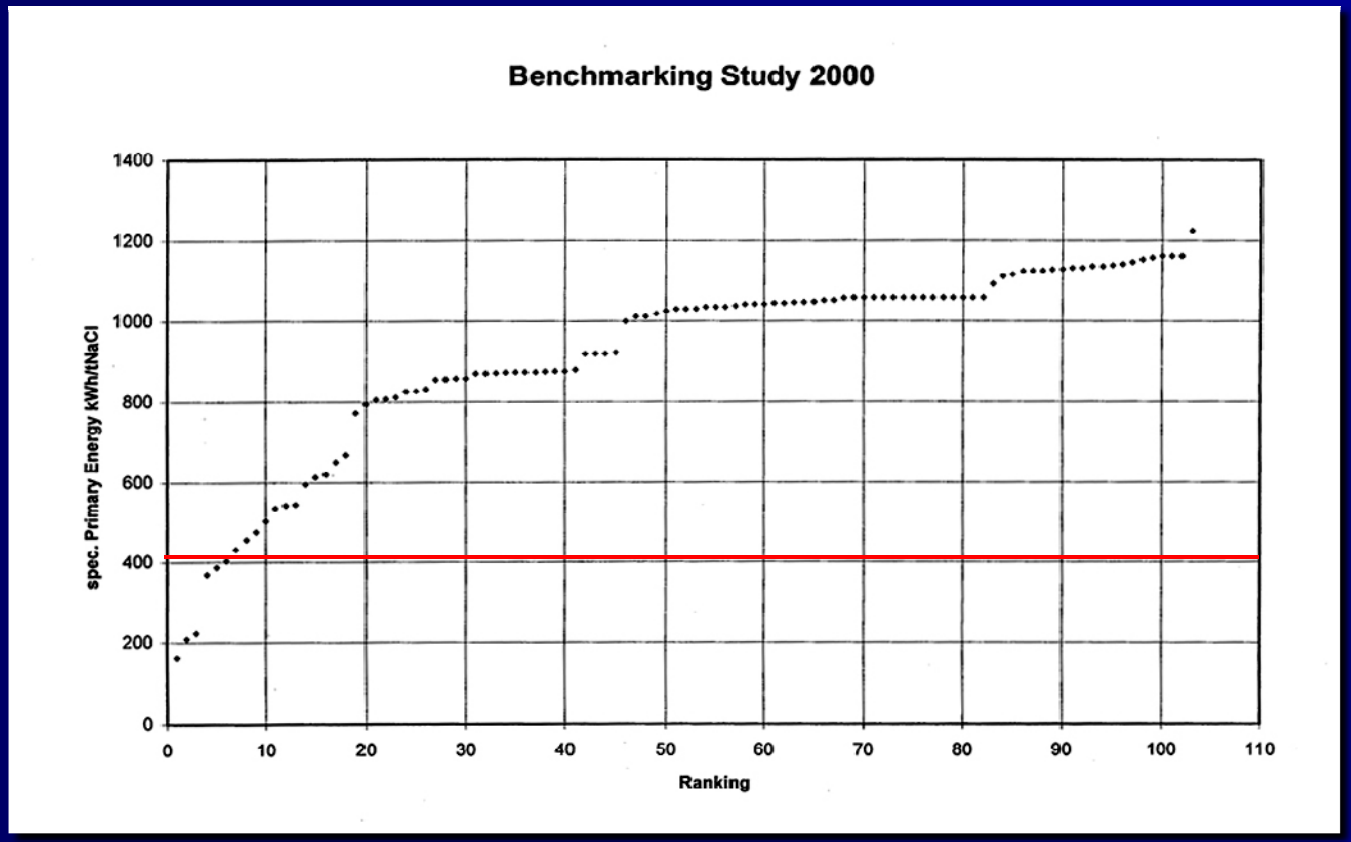
Energy Consumption Benchmarking Study



96 out of 103 thermal salt evaporating plants use more than theoretical amount of energy.

EVATHERM

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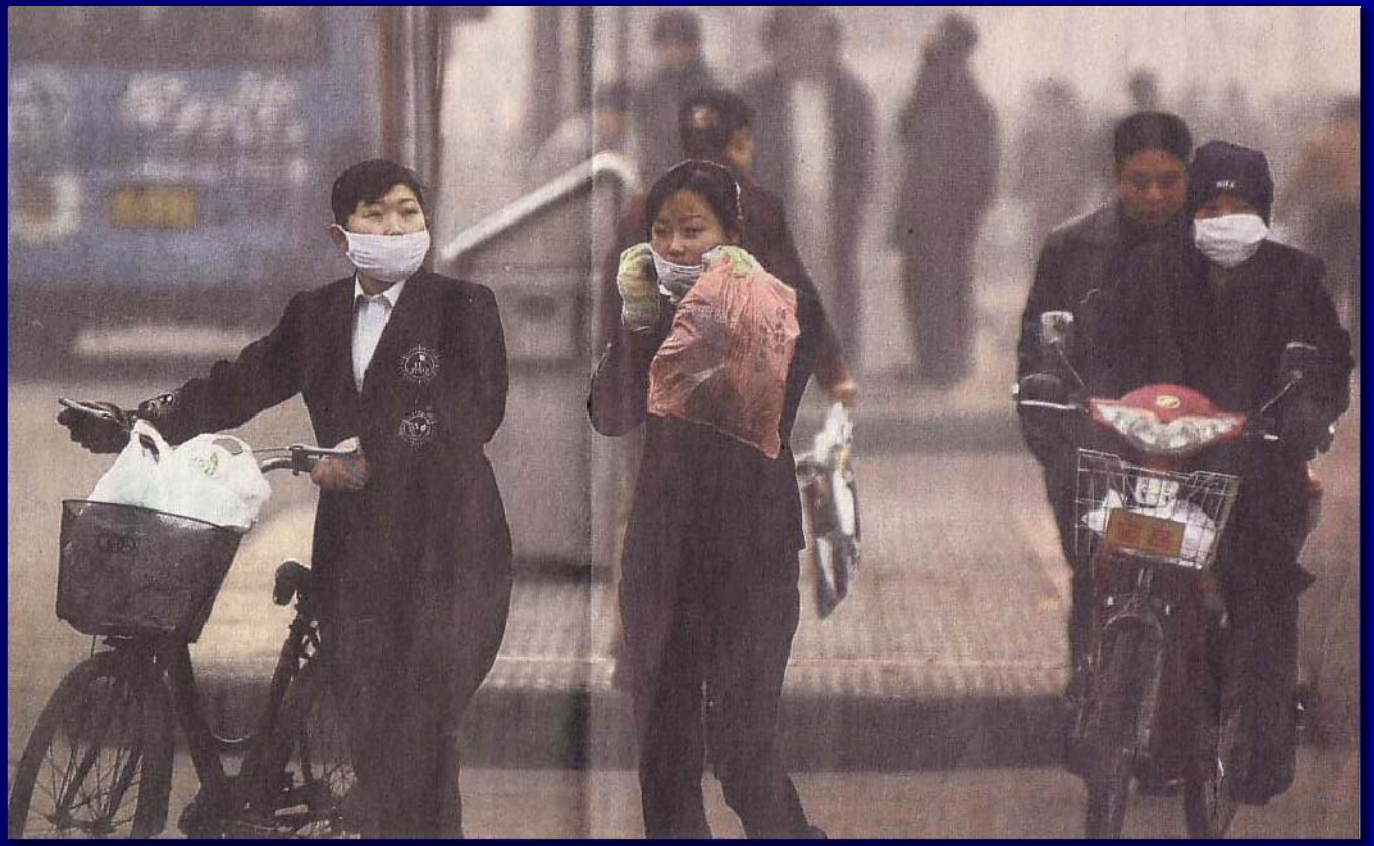
Air Pollution



WU HONG / EPA

Black coal is used to make steam for vacuum salt production in China.

13th Asian Chloralkali Conference, Kuala Lumpur, 26.6.2009

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Global Warming

NASA

Hurricane “Katrina” in the Gulf of Mexico on 29.8.2005.

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Destructive Climatic Change

Groenteman

In August 2005, hurricane “Katrina” destroyed large parts of New Orleans and surroundings. Increased hurricane activity is believed to be caused by global warming.

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Remedy No. 3

Compensate shortage with additional high quality solar salt production capacities

This option is highly desirable:

- **High quality solar salt is inexpensive**
- **Solar salt production employs renewable energy most effectively**
- **Solar saltfields are environmentally beneficial wetlands**

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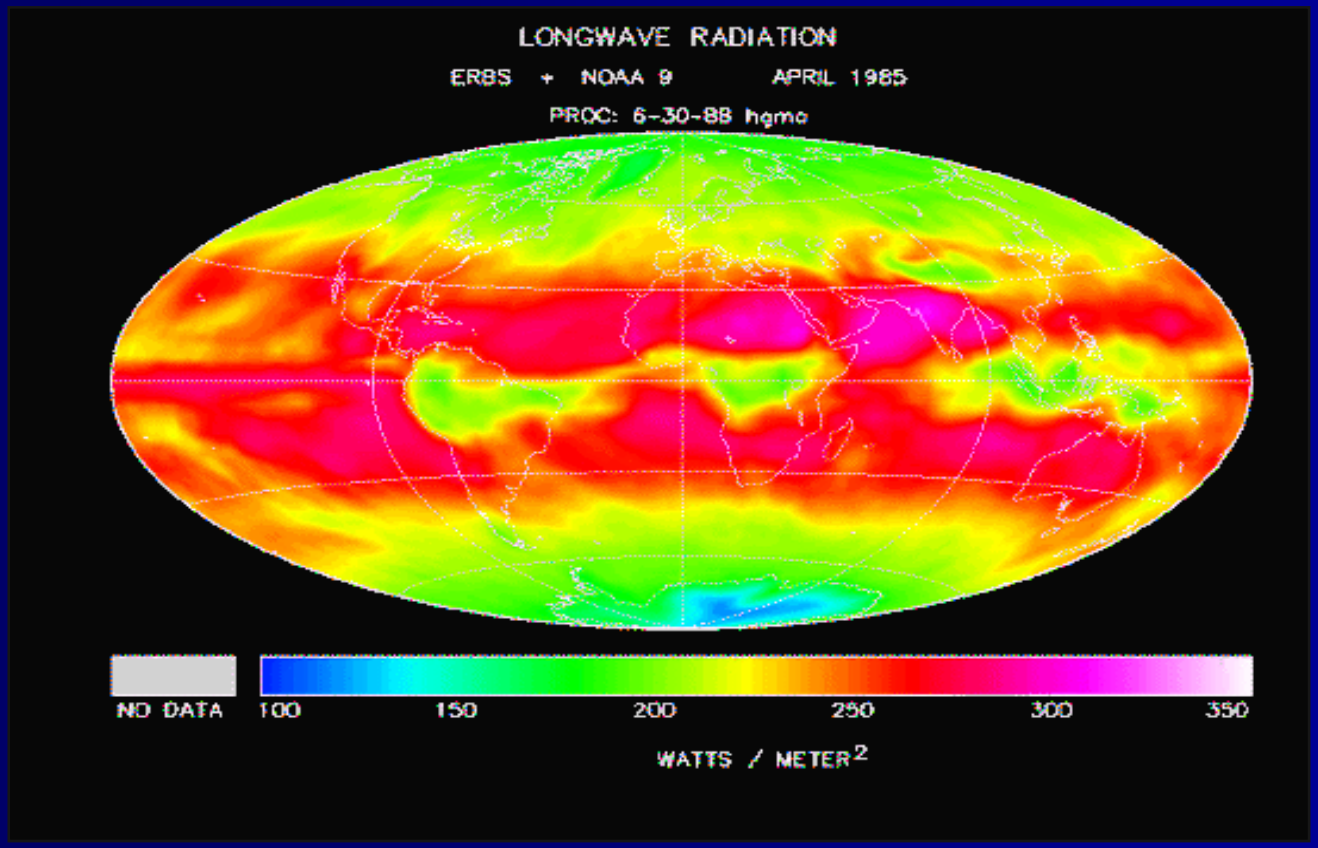
Solar Energy on the Planet Earth



NASA

Locations with highest rates of evaporation, suitable for solar salt production:

Caribbean Sea
North Africa
South Africa
Middle East
Western India
Western Australia

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Why not turn your solar salt into gold?

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