

# Evaluation Report Teluk Chempedak Oct 2005

## Beach Nourishment combined with the SIC System



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## **Beach Nourishment project combined with the SIC system in Teluk Chempedak.**

Teluk Chempedak is placed on the East Coast of Malaysia in Kuantan.

### **Weather Conditions.**

#### **Wind direction/speed**

In the Inter Monsoon time from March to October the wind direction primary is southeast.  
In the monsoon time from October to March the wind direction primary is northeast.  
The wind speed is less than 10 meter/sec.

#### **Rainfall.**

The rainfall in Kuantan is aprx. 2,5 metre per year.  
The rainfall can be up to 1,11 metre over 5 days in the monsoon time.

#### **Tidal Water.**

The range of the tidal water is aprx. 2,5 metre.

#### **Sediment transport inside the pocket bay.**

There is no sediment input from the sea in the pocket bay.  
In the inter-monsoon time the sediment transport direction in the bay is from south to north.  
In the monsoon time the sediment transport direction in the bay is from north to south.

#### **Activities.**

The beach in front of Hyatt and Sheraton hotel is pre-drained with the SIC system in July 2003.

The beach is nourished with 177.000 m<sup>3</sup> sand from May to July 2004.

After the nourishment, the beach is drained again with the SIC System.

#### **Survey.**

The Beach profile is surveyed three times a year in October, March and July.

#### **Evaluation.**

##### **Stabilizing period.**

After the beach nourishment is done from May to July 2004, the beach is stabilized in the period from July to October in an equilibrium profile.

Already in October 2004 the beach has found the new equilibrium profile.

The volume in the nourished area is reduced with 37.568 m<sup>3</sup> including the packing.

17.700 m<sup>3</sup> is reduced in the packing process.

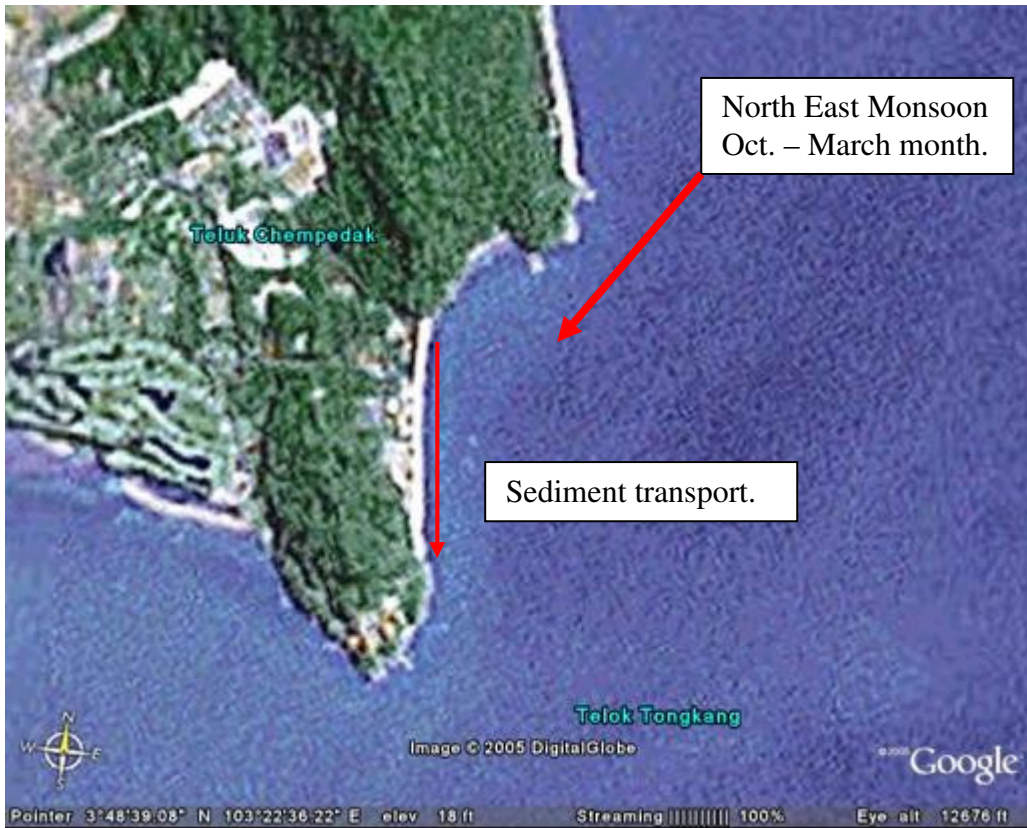
13.100 m<sup>3</sup> is placed in front of the rock's north of the nourished area, so it is now possible to walk to the other beach north of the nourished area.

##### **Operation.**

In the 1 year of the operation period Oct 2004 – Oct. 2005, only 8.405 m<sup>3</sup> were lost on the beach.  
The beach is extended 100 meter north in the inter-monsoon time.

# Sediment Transport

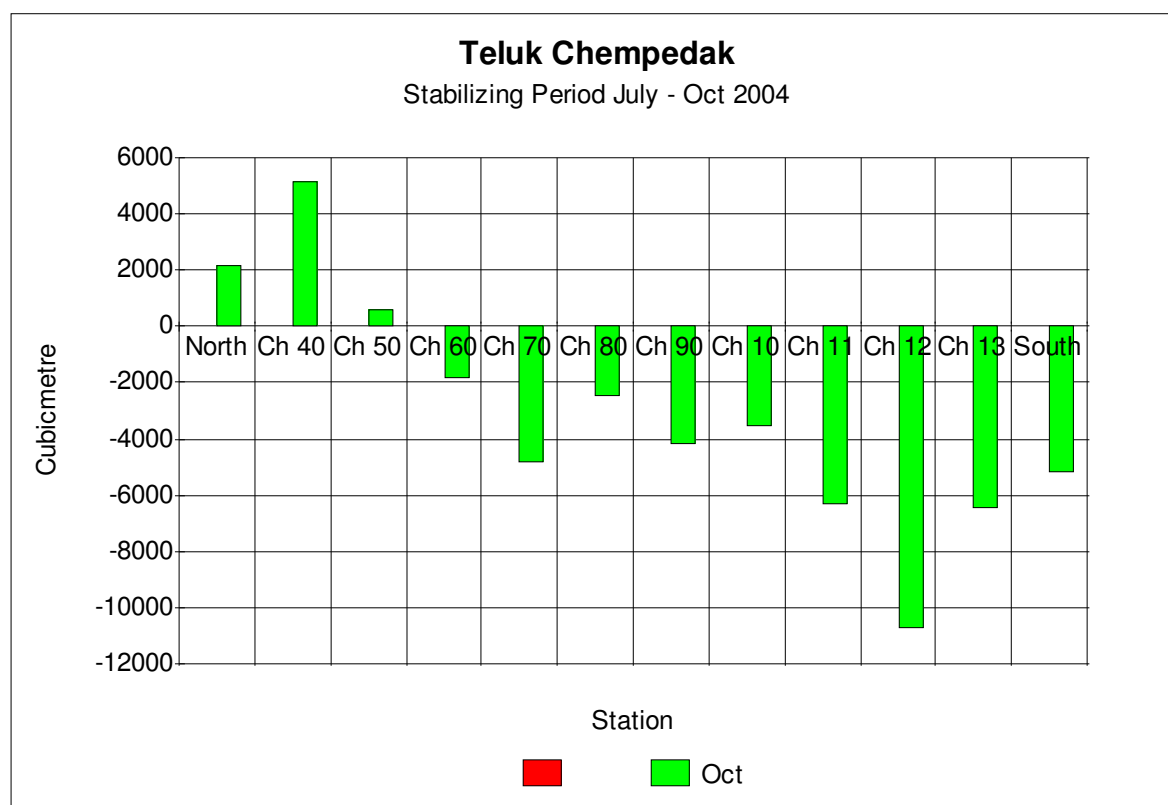
## Monsoon Time



## Inter-monsoon Time.



## Stabilizing Period July - October 2004



### Beach Nourishment/Sand Packing

In the period from May to July 2004 the beach is nourished with 177.000 m<sup>3</sup>

In the first 3 month we have a reduction in the volume total 37.500 m<sup>3</sup>

In the packing process the sand volume is reduced with 10 % 17.700 m<sup>3</sup>

Net. sand loss July – October 2004. 19.800 m<sup>3</sup>

The sand was placed in a 2 metre thick layer out to 130 meter from the reference line against the sea.

After the first 3 month the sand is stabilized in a new equilibrium profile.

### Sand-movements.

The nourishment is done in the inter-monsoon time, where the current is direction north.

Analyses of the survey shows, that 13.100 m<sup>3</sup> have taken place north of the nourished area around ch. 300.

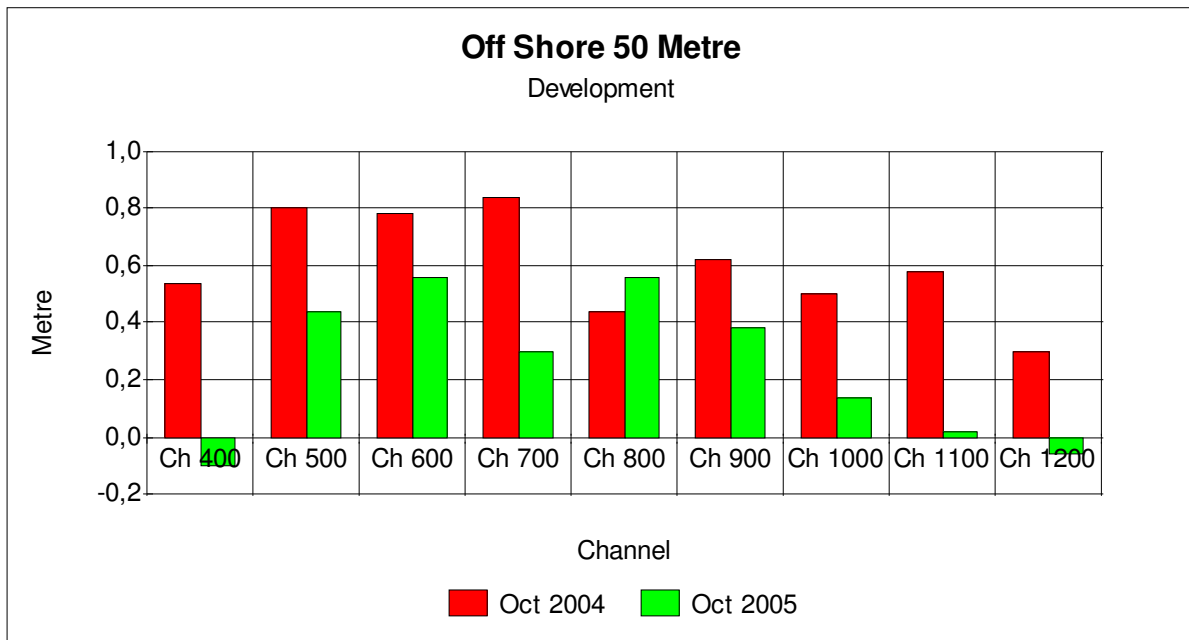
The other 6.700 m<sup>3</sup> is gone outside in direction to the sea.

Analyses of the area 50 m x 1000 m outside the nourished area shows in the October survey 2004, that the seabed is raised average 60 cm on 50.000 m<sup>2</sup> equal to 30.000 m<sup>3</sup>.

We have afterwards registered a new bar system in front of the beach.

Further analyses shows that 12.500 m<sup>3</sup> is spill over effect from the beach nourishment.

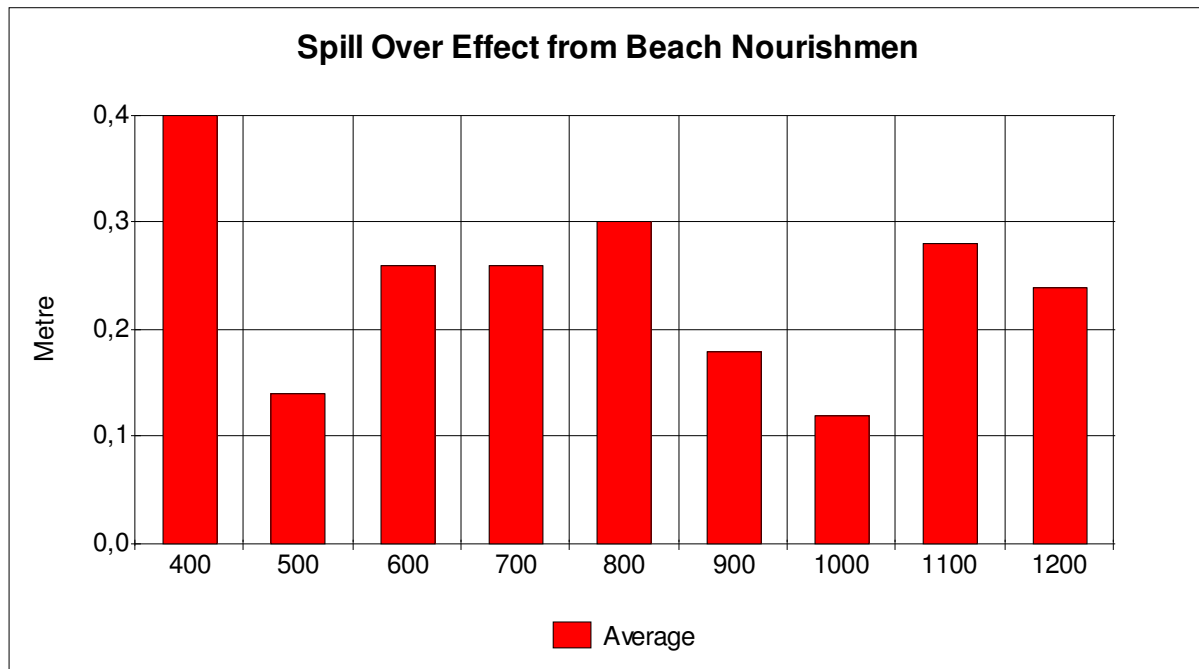
**Off Shore Conditions.**



Bar System Oct. 2004						
	10 m	20 m	30 m	40 m	50 m	Average
Ch 400	0,6	0,4	0,5	0,8	0,4	0,54
Ch 500	0,8	1,1	1	0,7	0,4	0,8
Ch 600	0,8	1,1	0,7	0,9	0,4	0,78
Ch 700	1,1	1,1	1	0,6	0,4	0,84
Ch 800	0,3	0,6	0,6	0,5	0,2	0,44
Ch 900	0,8	1	0,8	0,3	0,2	0,62
Ch 1000	0,9	0,8	0,5	0,1	0,2	0,5
Ch 1100	1	0,8	0,6	0,3	0,2	0,58
Ch 1200	0,5	0,4	0,3	0,2	0,1	0,3
	0,7555556	0,8111111	0,6666667	0,4888889	0,2777778	0,6
Bar System Oct 2005						
	10 m	20 m	30 m	40 m	50 m	Average
Ch 400	0	-0,3	-0,1	-0,1	0	-0,1
Ch 500	0,6	0,9	0,6	0,2	-0,1	0,44
Ch 600	0,6	0,8	0,8	0,4	0,2	0,56
Ch 700	0,9	0,6	0,3	-0,1	-0,2	0,3
Ch 800	0,5	0,9	0,8	0,4	0,2	0,56
Ch 900	0,9	0,6	0,4	0,1	-0,1	0,38
Ch 1000	0,5	0,3	0	0	-0,1	0,14
Ch 1100	0,3	0	0	0	-0,2	0,02
Ch 1200	0,2	0,1	-0,1	-0,2	-0,3	-0,06
	0,5	0,4333333	0,3	0,0777778	-0,0666667	0,2488889

The off shore area in the front of the nourished area is 50.000 m<sup>2</sup>.  
The average off shore bed level is raised with 60 cm in the stabilizing period from July - October 2004.

**Spill Over Effect Beach nourishment May – July 2005.**



In relation to the beach nourishment we have registered a spill over effect from the nourishment. The data is based on the survey Mach to July 2005.

Spill over effect from the beach nourishment.							
	10	20	30	40	50	Average	
400	0,7	0,5	0,3	0,3	0,2	0,4	
500	0	0,2	0,1	0,1	0,3	0,14	
600	0,6	0,3	0,1	0,1	0,2	0,26	
700	0,2	0,3	0,3	0,3	0,2	0,26	
800	0,8	0,4	0,1	0,1	0,1	0,3	
900	0,1	0,1	0,3	0,2	0,2	0,18	
1000	0,2	0,1	0	0	0,3	0,12	
1100	0,2	0,3	0,4	0,3	0,2	0,28	
1200	0	0,3	0,3	0,2	0,4	0,24	
Average	0,311	0,278	0,211	0,178	0,233	0,242	Total

The spill over effect is 12.000 m<sup>3</sup>

**Outside Area North Ch 300.**

Ch 300 Oct 2004									Average		
1,8	2,2	1,8	2,4	2,5	1,8	0,4	0,1	0,1	1,456	13100	Cubic Metre
Ch 300 Oct 2005					Average						
0,9	2	1,5	0,3	0,5	1,04	5200	Cubic Metre				

Calculation of sand volume in Ch. 300 north of the nourished area.



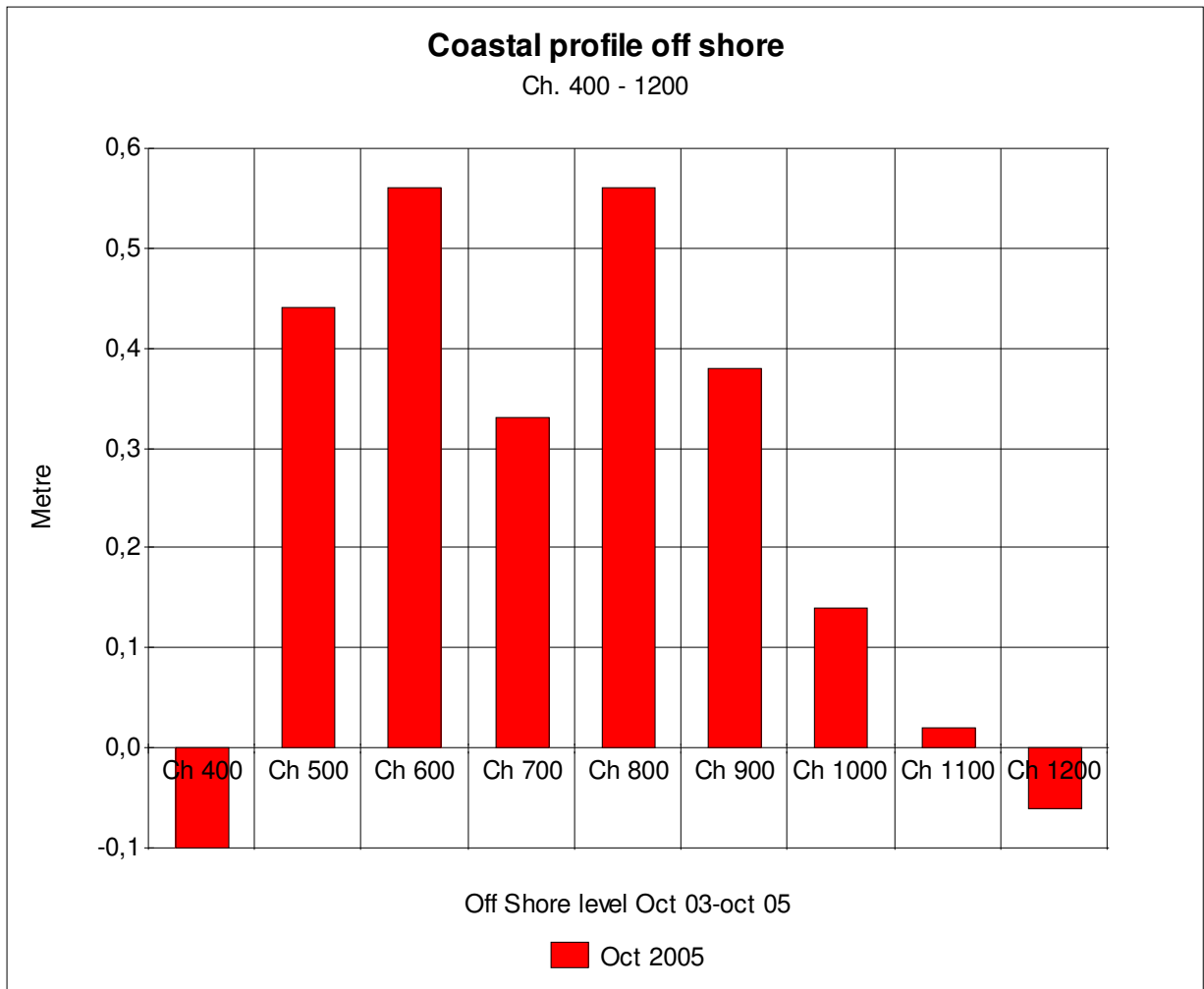
The picture show the situation in Oct 2004, where 13.100 Cubic Meter sand was placed north of the nourished area after the stabilizing period from July - Oct 2004

In October 2005 we have registered an equal situation, but only 5.200 m<sup>3</sup> was placed in front of the rocks in ch. 300.

**Bar system.**

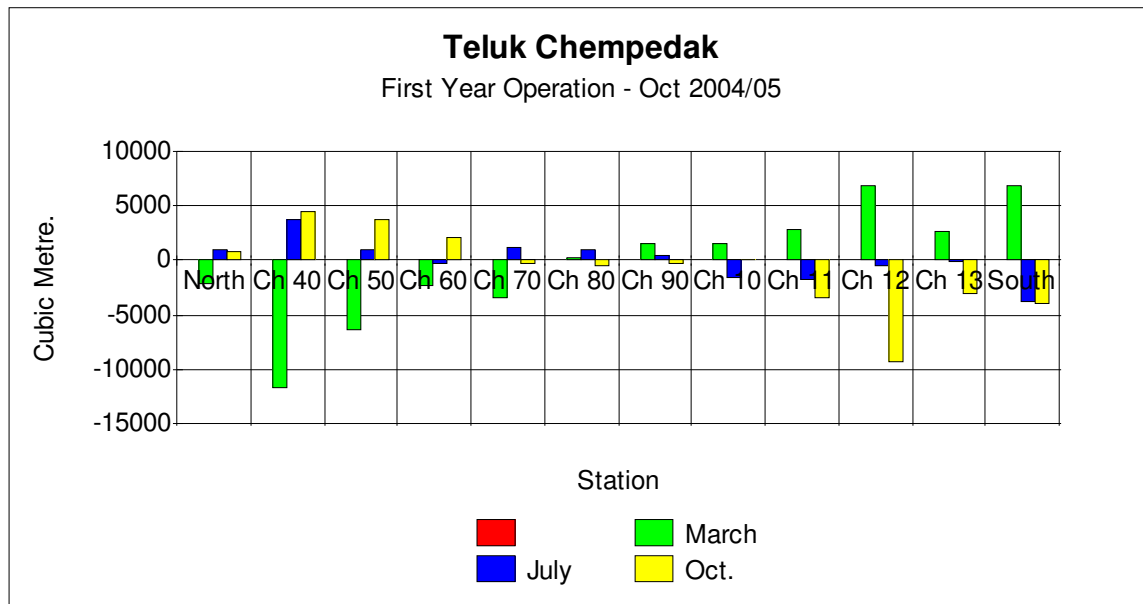


After the beach nourishment May – July 2004, we have registered a bar-system outside the beach with breaking waves.



We see clearly the SIC effect outside the drained area.

**Operation year 1 - October 2004/05**



**Beach development**

	Oct-March	March-July	July-Oct	
Northern Slope	-2064,4	993,6	746,1	m3
Ch 368/468	-11770,7	3748,2	4435,4	m3
Ch 468/568	-6293,8	953,1	3683,5	m3
Ch 568/668	-2259	-316,1	2051,3	m3
Ch 668/768	-3502,2	1243,8	-277,3	m3
Ch768/868	276,6	1029,6	-563,1	m3
Ch868/968	1530,5	392,6	-373,6	m3
Ch968/1068	1520	-1574,3	19,7	m3
Ch1068/1168	2905,3	-1701,4	-3477,7	m3
Ch1168/1268	6924,9	-463,1	-9347,3	m3
Ch1268/1300	2671,2	-128,1	-3079	m3
Southern Slope	6856,7	-3810,5	-3941,1	m3
Development	-3204,9	367,4	-10123,1	-12960,6 m3

**Monsoon time.**

The sand loss in the beach is only  $-3204,9 \text{ m}^3$  in the monsoon time from October to March.

**Inter-monsoon time.**

From March to July the beach is increased with  $367 \text{ m}^3$

From July to Oct 2005 the beach is eroded with  $-10123 \text{ m}^3$ .

From July - October 2005 is  $5.200 \text{ m}^3$  gone to the north in Ch 300, but is not lost in the profile.

The total loss inside the nourished area is  $12.960 \text{ m}^3$ . in year 1 in the operation period Oct. 2004/5.

## **Conclusion**

The sand movement in the stabilizing period July – Oct 2004 is 19.800 m<sup>3</sup> out of the nourished area, but the sand is still inside in the bay.

3.205 m<sup>3</sup> sand of the nourishment is lost south out of the bay in the monsoon time from Oct 04 to March 05.

5.200 m is gone to the north in ch. 300 during the inter-monsoon time, but is still inside in front of the rocks.

5000 m<sup>3</sup> is gone off shore in the inter-monsoon time and is lost.

The conclusion is that 8.405 m<sup>3</sup> is lost in year 1 from Oct 2004 – Oct 2005.

The beach is extended 100 meter north in the inter-monsoon time.

In relation to the net. beach nourishment on 159.300 m<sup>3</sup>, the loss is 5,3% in the first year.

Malaysia 04.12- 2005.

Poul Jakobsen.

## **Appendix**

The SIC system is now being tested on the west coast of Jutland in Denmark, and controlled by Professor Hans Falk Burcharth AUC and professor Jørgen Fredsøe DTU.

The west coast of Jutland is a very rough place with wave heights up to 6 metre and wind speed up to 33 m/sec.

The result after 6 month shows an increase on 265.000 m<sup>3</sup> in the area with the SIC system and only 27.000 m<sup>3</sup> in the area without the drain system.

The project is 11 km.

5,6 km with the SIC drain system and the reference area's 5,4 km.

The long shore sediment transport in the area is 2,3 mill. m<sup>3</sup> net. per year.

The drained area of the beach is now stabilized in an equilibrium profile 4x 100 metre.

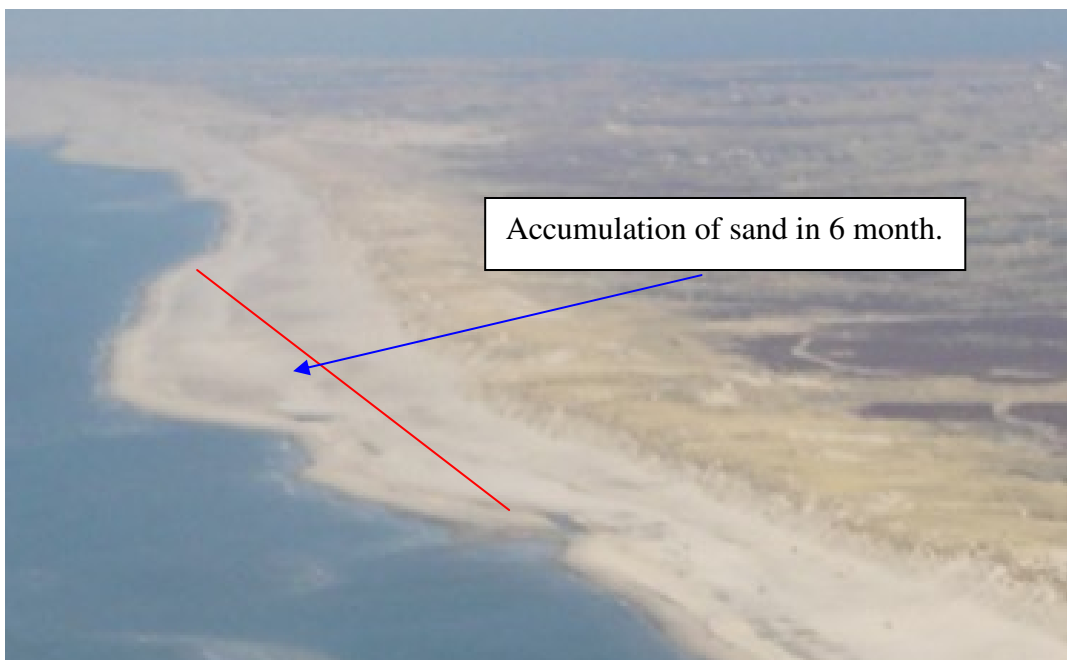
100 meter wide and 4 meter high in the dune foot.

On this background we know, it will be possible to stabilize the east coast of Malaysia with the SIC System.



# Environmentally Friendly Coastal Protection Pilot Project

## Southern Holmsland Barrier on the Danish West Coast



Test area 2

The **beach width** has increased up to 65 metre, 34 Metres average  
in test area 2

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## Project area.

The Project is situated between Hvide Sande and Nyminddegab on the Holmsland Barrier at the Danish West Coast.



Fig. 1

Reference area 1	st. 9200 – 11000
Project area 1	st. 4500 – 9200
Reference area 2	st. 2800 – 4400
Project area 2	st. 1800 – 2700
Reference area 3	st. 0 – 1700

As illustrated in fig. 1 , the Project is divided in areas with PEM modules (5600 Metres total) and reference areas (5400 Metres total).

The purpose is to measure and document the effect of the SIC System in comparison with the areas without the modules.

### **Results of surveys January, April and July, 2005.**

The survey and data in this project are done by the independent consulting engineering company Carl Bro A/S.

The results shows, that the sand accretion where the beach is drained by the SIC System is 10 times greater, than the areas with no modules.

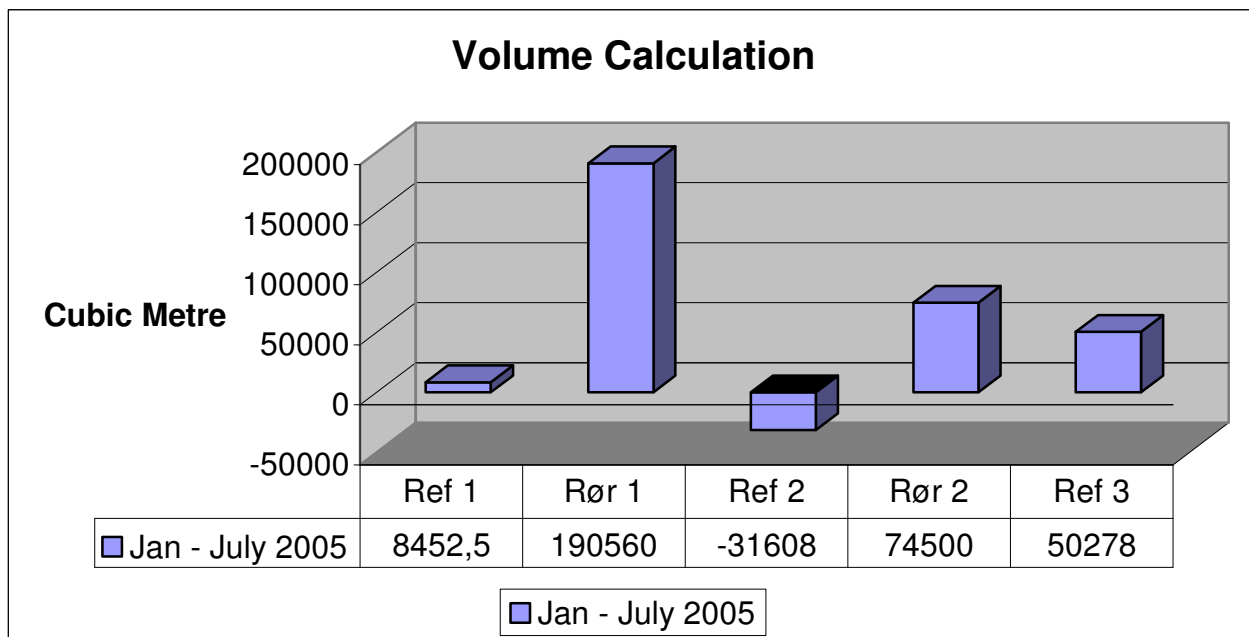
The increase of sand in the pressure equalized areas was 265.000 m<sup>3</sup> (5.600 Metres) , compared with the reference areas (5.400 Metres), where the sand accretion only was 27.000 m<sup>3</sup>.

However, these results will not appear in the first 6 month official evaluation report, as all data has to be recalculated, so volume the calculations shows the total volume accretion of sand on the test areas where there has been accumulation .

SIC do not agree in the statement, which says, that the beaches will build up during the summer period. We can prove it by the results in reference area 1 and 2. In Ref 2, there has been an erosion of 31.000 m<sup>3</sup> on the beach during the summer period, which resulted in a decrease in beach height of -24 cm in Ref 2.

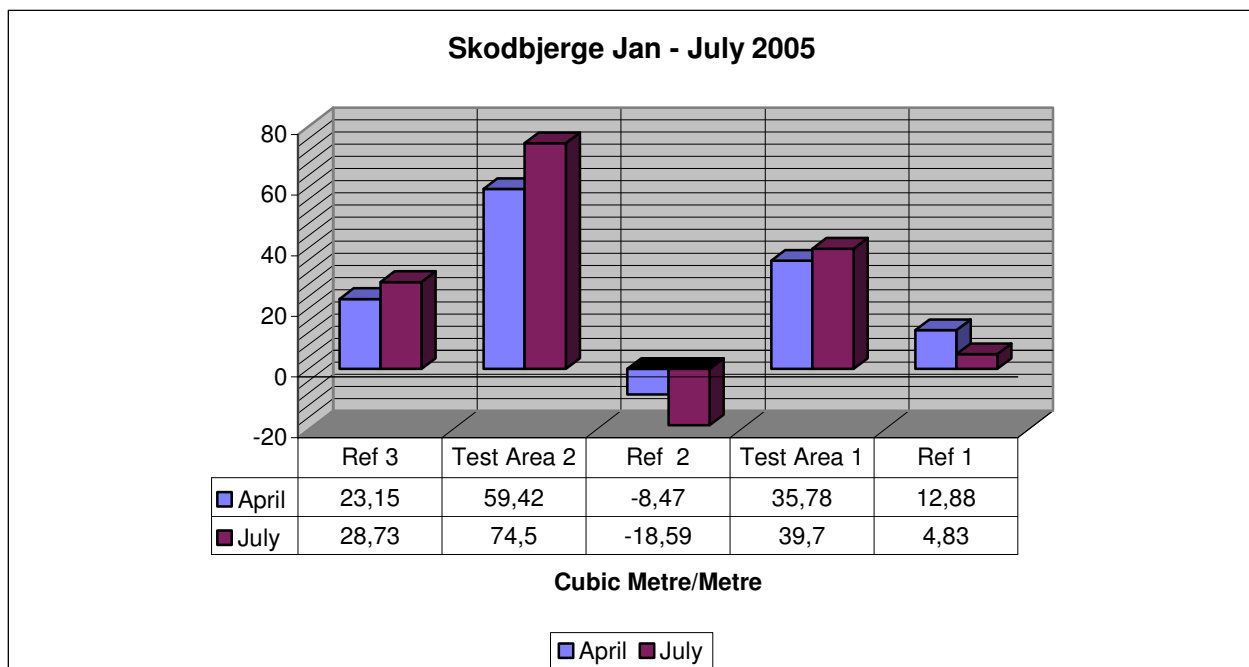
Therefore we can expect damages on the dunes in reference area 1 and 2 during winter 2005/6, like the erosion damages we have seen on the Søndervig Beach during winter 2004/5.

**SIC Field test Holmsland Barrier**  
6 month result 2005



The increase of sand in the pressure equalized areas was 265.000 m<sup>3</sup> , compared with the reference areas where the sand accretion only was 27.000 m<sup>3</sup>.

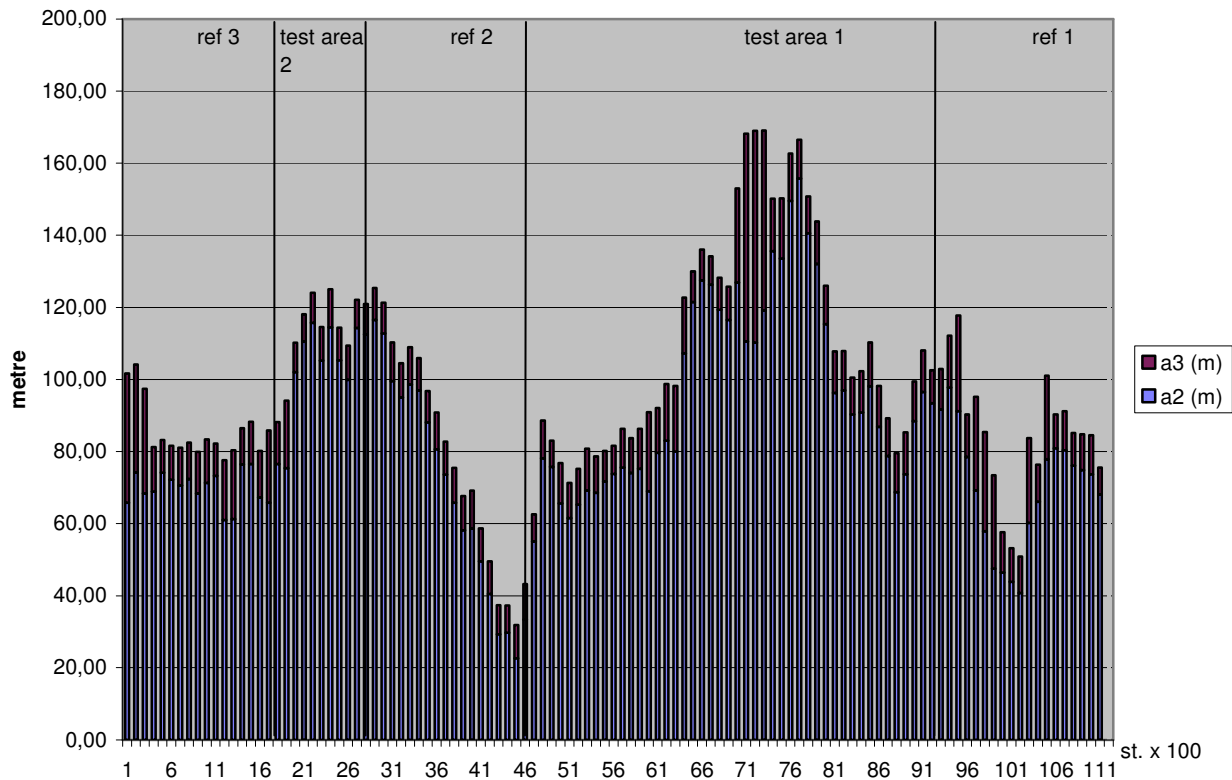
The Project is divided in areas with PEM modules (5600 Metres total) and reference areas (5400 Metres total).



The figure shows the sand accretion/erosion in m<sup>3</sup> along the beach.  
The result are significant.

## Beach Width.

Beach Width July 2005



The beach width is between 80 and 120 Metres in test area 1 and 2 and the beach is elevated average by 38 cm in the test area 1, and 66 cm in test area 2.

In test area 2 is the average beach width increased from 78 Metres to 112,4 Metres from January to July 2005.

In contrast to the test areas, reference area 2 beach elevation has decreased by -24 cm.

We can expect damages to the dune in reference area 1 stn. 10000 , where the beach width only is 50 Metres.

We can expect huge damages to the dune in reference area 2 stn. 4100-4300 , where the beach width is only 20 Metres.

SIC is now briefing the Minister of Transport about the risk of severe damage in the reference areas 1 and 2, and we are recommending that the SIC System is implemented in these areas.

It has been decided in the project group, that a new calculation model will be used in the project, because the current models can not be used on advancing beaches in the test areas.

Skagen d. 11 October 2005.

Poul Jakobsen