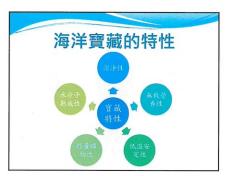
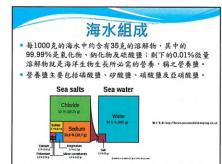
臺北市松山工農國際教育課程「化學寶藏在海洋」教學簡報 (中文版)

2022/7/4



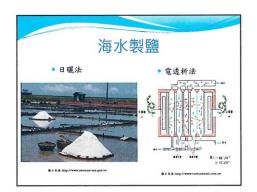




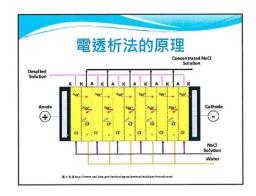














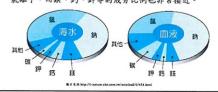


生命之海

- 孕育胎兒的子宫裡,都有著一個充滿胎兒所需養分的 小小的海洋: 羊水!
 海水中含有將近97%的水,其餘則為營養鹽類、礦物質、微量元素等成分
- 質、假聖九素寺成分。 等本水中也含有98~99%的水分。雨者間的鈉、鉀、氣 等成分與含量,皆极為相近。 等水甚至與海水一樣,有點鹹鹹的味道呢!若說海洋 是生命之源,著實一點兒也不為過。

海洋營養鹽

- 海水與血液的組成比例,極為相似。血液中55%都是血漿,而血漿的含水量約為92%;除了水之外,就是鈉、 鉀、鈣、鎂、氣等成分。
- 海水與血漿的組成比例相近: 兩者的主要成分都是鈉及 氯離子,而鎂、鈣、鉀等的成分比例也非常接近。



海洋營養鹽

- 磷酸鹽與硝酸鹽是海洋植物行光合作用合成有機物的 原料。
- 海洋浮游植物的分布與硝酸鹽的濃度有關。 當海水表 層的浮游植物增長, 則硝酸鹽濃度降低; 深海的硝酸 鹽濃度高且穩定。
- 硝酸鹽是氮肥的來源。
- 矽酸鹽是矽藻細胞壁的主要構成材料。
- 磷酸鹽在海洋中的含量遠低於硝酸鹽,是浮游植物生 長主要的限制因子。





磷礦的重要性

- 農作物生長的三要素: 氮、磷、鉀。 缺乏時將造成人類的 糧食危機。
- 氮可從空氣中獲取,磷和鉀卻必須從土地中開採。
- 數可從空氣中獲取,偏和郵卻必須從土地中間採。 · 确是生物細胞質的重要組成元素,也是植物生長必不可少 的一種元素。世界上84%~90%的磷礦用於生產各種礦肥, 3.3%生產例料添加劑、4%生產洗滌劑,其餘用於化工、 粒工、國防等工業。
 全世界的郵存量足堪使用數個世紀。全球磷礦預計在一世 比內間採完單,磷礦濱渝的合作底海還不平均,全球磷 礦有辦近40%蘊藏在出非的摩洛哥。
 現代農耕方式讓土壤裡的磷元素還流排入水體以後,水裡 的磷分量太高會造成藻華,消耗魚類所需要的氧氣,形成 f.死區」。

磷礦耗竭的新契機-鳥糞

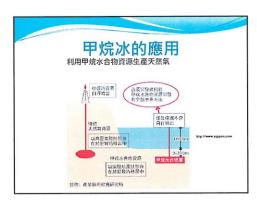
- 海鳥翼(Guano)又稱鳥翼石,鳥翼石通常產於低緯度的 海島,主要為海島所產生的大量翼便與未被消化的魚賣等 食餘。
- 從成分上來講,海島翼是多種钙磷酸鹽的混合物,包括鈣磷礦 (CaHPO₄)、白磷磷磷 (CaHPO₄)、白磷磷磷 (CaHPO₄)、白磷粉礦 (Ca₄Mg,Fe)[HPO₄/(PO₄)₆]) 以及各類磷灰石、磷酸鹽和有機物等。
- 一般過程長期的累積所形成,因含有豐富的磷,為製作磷肥的良好原料,具有經濟價值,台灣包括棉花嶼、貓嶼、草嶼、草嶼、本平島與東沙島這獎個曾經盛在鳥壤石的島嶼在日據時期就已被開發殆盡。











海洋寶藏-甲烷冰經濟價值

- 國外的調查報告顯示,全球天然氣水合物所含的甲烷氣資源量,在標準溫壓環境下,保守估計至少有兩萬兆立方公尺,其中所含的有機碳總量達到10兆公順,也就是大約為目前已知全球石化燃料等能源資源中,有機碳總儲量的兩倍!
- 經濟部中央地質調查所證實台灣西南部海域蘊藏豐富的天然氣水合物。各項調查的資料初步估計,在10,000平方公里面積的海域海床,以水合物型式存在的天然氣應在5,000億立方公尺以上,以目前國內天然氣的年使用量70至80億立方公尺計算,足可供全台使用60年以上。

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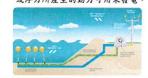


寶藏的種類-能源

- 專家估計,全世界海洋能的蘊藏量為750多億千瓦, 這些海洋能源都是取之不盡、用之不竭的可再生能源。
- 能種類
 - > 波浪能
 - > 湖汐能
 - >海洋溫差能
 - > 海流能 >海洋鹽差能

能源寶藏—波浪能

- 海洋漢書是由太陽能轉換而來,因為太陽輻射的不均勻 加熱與地殼冷卻,加上地球自轉而造成風。風吹過海面 又形成波浪,因此由波浪產生的能量與風速成一定正比。
- 波浪起伏會造成水的運動。水波運動的位能差、往復力 或浮力所產生的動力可用來發電。



能源寶藏—潮汐能

就是利用漲潮與退潮高低變化來發電,與水 力發電原理類似。漲潮時,海水自外流入,推動水輪 機產生動力發電;退潮時,海水退回大海,再一次推 動水輪機發電。





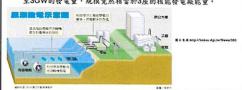
能源寶藏—海洋溫差能

- 海洋溫差能是利用海洋的表層海水與深層海水之間不同的溫度 造過溫差汽化工作流 體帶動渦輪機發電。
- 溫差若愈大,則海洋 熱能轉換之效率愈高,



能源寶藏—海流能

- 是利用海洋中的洋流流動推動水輪機發電,一般均在 海流流輕處設置截流漏洞的沉箱,並在其中設置一座水輪發電 機,現發電需要增加多個機粗。 公民,且洋流非常穩定,初步估計光是線島附近的黑潮流就可達1 至3GW的發電量,規模竟然相當於3座的核能發電廠能量。



能源寶藏—海水鹽差能

- 海水鹽差能是利用海水和淡水之間或兩種含鹽濃度不 同的海水之間的化學電位差能。在海水和江河水相交 匯處容易產生鹹淡水。
- 科學家經過周密的計算後發現在17°C時,如果有1莫 耳鹽類從濃溶液中擴散到稀溶液中去,就會釋放出 5500焦的能量來。



- 當把兩種濃度不同的鹽溶液倒在同一容器中時,濃溶液中的鹽類離子就會自發地向稀溶中擴散,直到兩者濃度相等為止。
- 其基本方式是將不同鹽濃度的海水之間的化學電位差能轉換成水的勢能,再利用水輪機發電。



K & 3 http://climatetechwiki.org/technology/jiqweb-ro

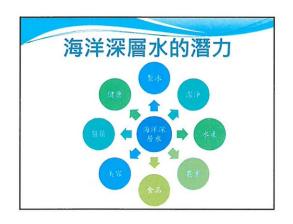


海洋深層海水與表層海水水質比較 一般項目分析 表層海水 深層海水 水溫 °C 21.0 13.1 pΗ 8.19 7.87 DO 8.33 7.28 mg/L TOC mg/L 1.60 0.93 生菌數 CFU/mL 103-104

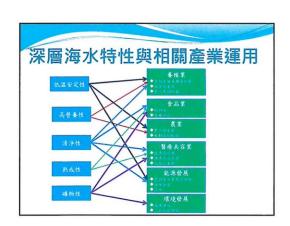
*/-	水間が	学小兴:	夜僧冯	水水質比
主要	元素分析	表層海水	深層海水	附註
Na	%	0.97	1.00	
Mg	%	0.13	0.133	
Ca	mg/L	421	426	
K	mg/L	406	419	
Br	mg/L	79.1	80.8	
Sr	mg/L	7.91	8.03	
В	mg/L	4.75	4.69	不足造成骨質流失
Ba	mg/L	0.025	0.045	
F	mg/L	0.53	0.50	

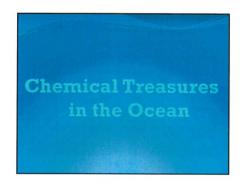
211	/小 / E	アリン	學衣眉	海水水質比
微量元	素分析	表層海水	深層海水	附註
Pb	μg/L	0.099	0.111	
Cd	μg/L	0.009	0.029	
Cu	μg/L	0.32	0.173	人體造血機能元素
Fe	μg/L	0.371	0.281	人體造血機能元素
Mn	μg/L	1.214	0.153	氧的活性基
Ni	μg/L	0.33	0.376	
Zn	μg/L	0.66	0.71	DNA合成及細胞分裂所需
As	μg/L	0.33	0.41	
Mo	μg/L	7.81	7.73	

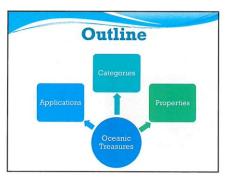
鹽類包	營養分析	表層海水	深層海水
NO ₃ -N	μg-at/L	1.49	25.9
PO ₄ -P	μg-at/L	0.34	1.65
SiO ₂ -Si	μg-at/L	13.6	64.2



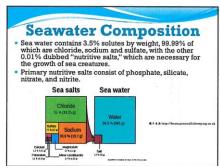


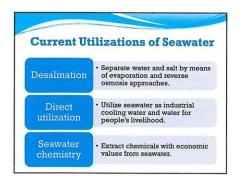




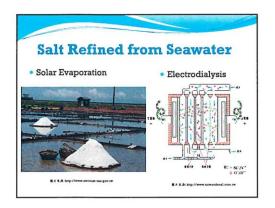


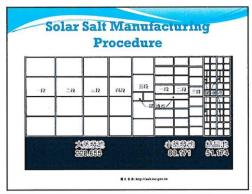


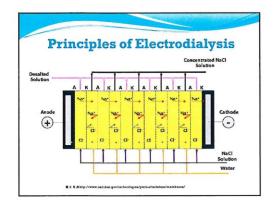


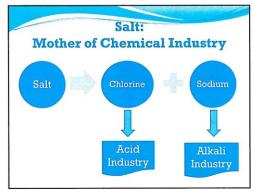












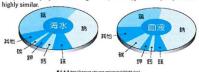


Seawater: Cradle of Life

- A woman's womb contains a small ocean— the amniotic fluid that abounds with nutrients necessary for fetuses.
- Water accounts for 97% of seawater's composition, and the remaining 3% includes nutritive salts, minerals, microelements, etc.
- Water also accounts for 98-99% of amniotic fluid. The ratios of sodium, potassium and chlorine in seawater and in amniotic fluid are nearly identical.
- Amniotic fluid tastes as salty as seawater! It is far from exaggerating to deem the ocean as the origin of lives.

Oceanic Nutritive Salts

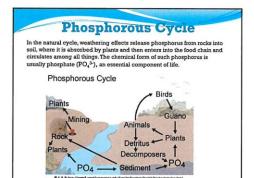
- The compositional proportions of seawater and human blood are highly similar. Plasma accounts for 55% of human blood, and water accounts for roughly 92% of plasma. The remaining 8% includes sodium, potassium, calcium, magnesium, chlorine, etc.
- The compositional proportions of seawater and plasma are similar. The primary elements of them are sodium ions and chlorine ions. Their compositional proportions of magnesium, calcium, potassium, etc., are also highly similar.



Oceanic Nutritive Salts

- Phosphate and nitrate are the raw materials for marine plants to synthesize organic matters via photosynthesis.
- The distribution of phytoplankton in the ocean is subject to the concentration of nitrate. The concentration of nitrate decreases in the surface layer of seavater where phytoplankton grows. The concentration of nitrate in the deep ocean is high and stable.
- Nitrate is a source of nitrogen fertilizer
- Silicate is the primary component of diatom cell walls.
- Phosphate is far less in amount than nitrate in the ocean, which is the main factor that limits the growth of phytoplankton.

Nitrogen Cycle What is the finance of the finance



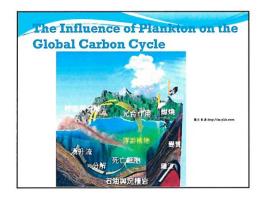
The Significance of Phosphorites

- Crop growth rolles on nitrogen, phosphorus, and potassium, a lack of which will result in a food crisis for humanity.
- Nitrogen can be obtained from the air. Meanwhile, phosphorus and potassium shall be extracted from the land.
- Phosphorus is an important component of biological cytoplasm. It is also essential for plant growth 64% to 80% of phosphorites of the earth is used to produce various phosphate fertilizers. Another 3.3% is used to produce foed additives, which somber 4% is used to produce detergents, and the remaining is widely used in other industries, such as chemical industry, light industry, defense industry else.
- The world's potassium reserves can be extracted for a few conturies to come, but the phosphate reserves are expected to be depleted within one century. The distribution of phosphorites is less even than that of crude oil. About 40% of thomshorites are meserved in Moneyon.
- Modern agriculture allows phosphorus of the soil to drain into the water, where the phosphorus level becomes too high and forms algal blooms that consumes the oxygen necessary for the fish population, giving rise to a "dead zone".

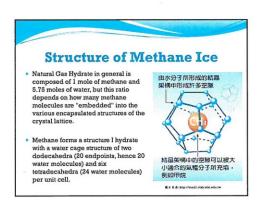
Guano: A Turning Point for the Draining Phosphorites

- Guano, also known as bird droppings, is usually produced on low-latitude islands. The main components of guano are seabird droppings and undigested fish bones and other food waste.
- Compositionwise, guano is a mixture of various calcium phosphates, including calcium phosphate (CaHPO4 - 2 H2O), trigonal calcium phosphate (CaHPO4), white calcium phosphate (CaS(Mg,Fe)[HPO4/(PO4)6]), and various types of apatile, nitrate and organic matters.
- Guano takes a huge amount of time to form. Rich in phosphorus, guano provides a good source of phosphorus fertiliser, making it a raw material with high economic value. Guano reserved no nell-shore islands of Taiwan had long been depleted during the Japanese occupation period.



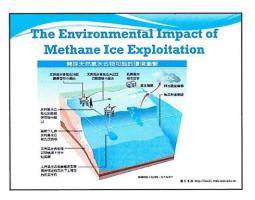








Economic Values of Methane Ice According to international scientific reports, global methane resources contained in natural gas hydrates, based on a conservative estimate, reaches at least an amount of 20,000 trillion cubic meters under standardized temperature and pressure. The total amount of organic carbon contained is 10 trillion metric tons, roughly tentamount to twice the amount of organic carbon necerves in known fossil fleel and other energy resources! The Central Geological Survey of the Ministry of Economic Alfairs has confirmed that the waters of southwestern Taiwan are rich in natural gas hydrates. According to preliminary estimates from various surveys, there should be more than 500 billion cubic meters of natural gas preserved in the form of hydrates on asea bed that covers a space of 10,000 km², which, based on the current domestic natural gas consumption (7 to 8 billion cubic meters per annum), would be sufficient for 60 years or more in Taiwan.

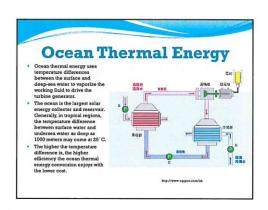


Diverse Marine Energies

- The global marine energy reserves are expected to exceed 75 billion kilowatt.
- Categories of marine energy
 - > Wave power
 - > Tidal power
 - > Ocean thermal energy
 - > Marine current energy
 - > Osmotic power

Wave Power Ocean waves are generated through the conversion of solar energy. The uneven heating of solar radiation, the cooling of the crust, and rotation of the earth may work together to form wind. As wind blows across the surface of the ocean, the continual disturbance creates waves. Hence, the wave-driven energy is to certain extent proportional to the wind speed. The circular motion of waves lead to water movement. The potential energy, reciprocal force, or buoyant force arising from water movements can be used to generate electricity.

Tidal Power * Tidal power refers to the kinetic power arising from the rise and fall of tides to generate electricity, which is similar in principle to hydroelectric power generation. In flood tides, the offshore seaware flows in pushing the specialized turbine to generate electricity, while in ebb tides, the seawater flows back pushing the turbine again to generate electricity. **ARIS** **



Ocean Current Energy Current power is extracted using ocean currents to drive turbine generators. In general cases, caissons with an interceptor culvert are installed at stream locations, where one or more turbine generators are installed. The Kuroshio (Black Stream) beside Taiwan flows at a depth of about 30 meters and a velocity of about 1 m/sec. At a preliminary estimate, the Kuroshio near the Green Island alone is able to generate 1-3 GW per annum, roughly tantamount to the total amount of electricity generated by three nuclear power plants combined a year.

Osmotic Power

- Osmotic power is the salinity gradient energy available from the difference in the salt concentration between seawater and river water. Where the fresh water and seawater converge is the ideal location to create brackish water.
- With careful calculations, scientists have confirmed that at 17°C, when 1 mole of salt diffuses from a concentrated solution to a dilute solution, there shall be 5,800 Joules of energy released.

Principles of Osmotic Power Generation

- When two salt solutions at different concentration levels are poured into the same container, the saltbased ions in the concentrated solution will spontaneously diffuse into the dilute solution until their concentration levels are equal.
- The basic idea is to convert the chemical gradient energy achieved from different concentration levels of seawater into water potential energy, hence driving the turbine generators.



K # http://chmatesechwik.org/sechnology/jsqweb-to

The Definition of Deep Seawater

Deep seawater refers to water at 200-300 meters below the surface level, where sunlight cannot penetrate and the contact with atmosphere does not exist. In the deep seawater zone, the photosynthesis and the plant plankton reproduction are impossible, creating a nearly aesthetic environment and a source of the least contaminated water on earth.



養 末 水為:http://www.laiwanyea-dow.com.iw

Water Quality Comparison between Deep Seawater and Surface Seawater General Analysis Items Surface Deep

General Ar	alysis Items	Surface Seawater	Deep Seawater
Water Temperature	°C	21.0	13.1
pH		8.19	7.87
DO	mg/L	8.33	7.28
TOC	mg/L	1.60	0.93
Bacteria Count	CFU/mL	103-104	*
	# # # . #:http://140.86.178.52/0	pload/QUARTC/000107/31-7.pdf	

Analysis of Major Elements		Surface Seawater	Deep Seawater	Remarks	
Na	%	0.97	1.00		
Mg	%	0.13	0.133		
Ca	mg/L	421	426		
K	mg/L	406	419		
Br	mg/L	79.1	80.8		
Sr	mg/L	7.91	8.03		
В	mg/L	4.75	4.69	Insufficient B element may result in bone loss.	
Ba	mg/L	0.025	0.045		
F	mg/L	0.53	0.50		

eep Seawater vs Surface Seawater Pb μg/L 0.099 0.111 0.009 Cdμg/L 0.029 Cu μg/L 0.32 0.173 Human hematopoietic function elements Fe 0.371 0.281 μg/L Human hematopoietic function elements Mn μg/L 1.214 0.153 Reactive oxygen species Ni μg/L 0.33 0.376 Zn μg/L 0.66 0.71 Required for DNA synthesis and cell division As µg/L 0.33 0.41 μg/L 7.81 7.73 Mo 資件未達:http://140.96.175.52/Upload:QUARTC/000107/31-7.pdf

	sis of Salt rients	Surface Seawater	Deep Seawater
NO ₃ -N	μg-at/L	1.49	25.9
PO ₄ -P	μg-at/L	0.34	1.65
SiO ₂ -Si	μg-at/L	13.6	64.2





