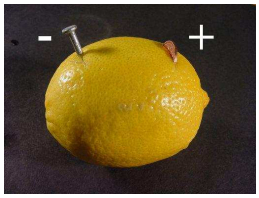
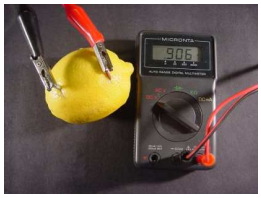
Bateria de acumulatori

Curs 3

1




2



Prehistoric batteries
Clay jar with iron rod surrounded by copper cylinder. When filled with vinegar + an electrolytic, solution produces 1.1 volts DC (circa. 250 BC to 640 ADO).
It is believed that the Parthians who ruled Baghdad (circa 250 BC) used batteries to electroplate silver.
The Egyptians are said to have electroplated antimony onto copper over 4300 years ago.




Volta and his battery.
In 1800, Alessandro Volta invented the first modern electric battery.
Volta demonstrated that an electrical current is generated when metals and chemicals come into contact.

3

History of Battery Development		
1600	Gilbert (UK)	Establishment of electrochemistry study
1791	Galvani (Italy)	Discovery of 'animal electricity'
1800	Volta (Italy)	Invention of the voltaic cell
1802	Cruickshank (UK)	First electric battery capable of mass production
1820	Ampère (France)	Electricity through magnetism
1833	Faraday (UK)	Announcement of Faraday's Law
1836	Daniell (UK)	Invention of the Daniell cell
1839	Grove (UK)	Invention of fuel cell (H_2/O_2)
1859	Planté (France)	Invention of the lead acid battery
1868	Leclanché (France)	Invention of the Leclanché cell
1888	Gassner (USA)	Completion of the dry cell
1899	Jungner (Sweden)	Invention of the nickel-cadmium battery
1901	Edison (USA)	Invention of the nickel-iron battery
1932	Shlecht & Ackermann (Germany)	Invention of the sintered pole plate
1947	Neumann (France)	Successfully sealing the nickel-cadmium battery
Mid 1960	Union Carbide (USA)	Development of primary alkaline battery
Mid 1970		Development of valve regulated lead acid battery
1990		Commercialization of nickel-metal hydride battery
1991	Sony (Japan)	Commercialization of lithium-ion battery

4

Cât de fiabile sunt autovehiculele?



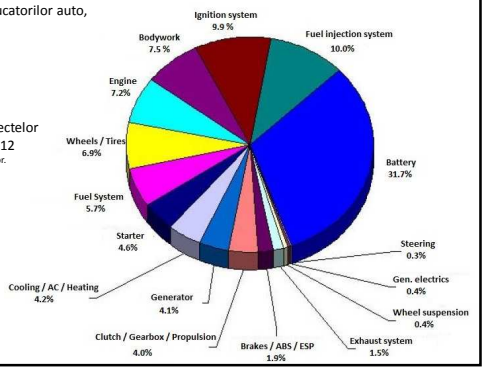
http://www.oeamtc.at/portal/adac-pannenstatistik-2013+2500+1399471#knot:0

5

Cât de fiabile sunt autovehiculele (cont.)?

Autovehicule nu mai vechi de 6 ani, cu specificatii tehnice neschimbate pentru cel putin 3 ani, cu cel putin 10.000 buc. vandute intr-un an, ce au necesitat interventia ADAC la cererea conducatorilor auto,

Distributia defectelor pentru anul 2012
Sursa: vezi link anterior.



6

1. Bateriile autovehiculelor

Bateria de acumulatori auto (baterie sau acumulator) reprezinta un dispozitiv electrochimic capabil sa produca energie electrica

1.1 Cerinte impuse bateriilor (auto)

- tensiune constanta
- curent mare
- reincarcabila
- raporturile energie/masa, energie/volum convenabile
- sa stocheze energie pe o perioada mare de timp
- capacitate mare si de durata
- durata de viata mare
- pret mic
- intretinere usoara

Temperatura de lucru
-30 +70 °C
Curenti solicitati
< 20-30A,
>200-600-800A,
≦30 mA

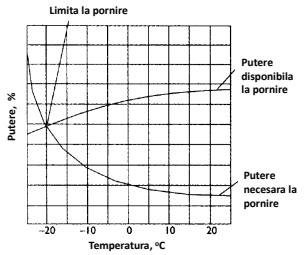
Influente:
marimea motorului termic,
starea tehnica a acestuia,
temperatura,
nivelul de dotare al autoveh.

- sa stocheze energie si sa o furnizeze rapid pentru pornirea motorului termic
- sa permita folosirea sistemelor electrice o durata mare de timp pe perioada nefunctionarii sistemului de incarcare
- sa preia fluctuatiile de tensiune (stabilizator) din sistemul de alimentare
- sa furnizeze energia suplimentara solicitata in timpul functionarii sistemului de incarcare

7

1.2 Alegerea bateriei

-asigurarea turatiei minime de pornire (temperaturi scazute)
-durata de functionare a accesoriilor cand sistemul de incarcare nu functioneaza



Producatorii auto:

Satisfac necesarul de CCA cu bateria incarcata 80% la -7°C.

8

1.2 Alegerea pozitiei bateriei

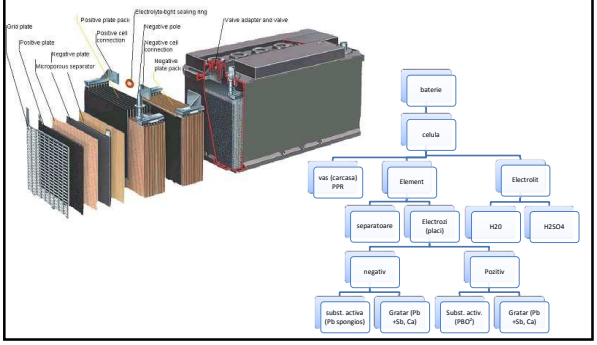
-Distributia maselor componentelor vehiculului (12V/58Ah, 242x175x175, 14,3kg)
-Distanta fata de demaror (reducerea lungimii conductorilor)
-Accesibilitate
-Protectie impotriva contaminarii
-Temperatura ambientala
-Protectie la vibratii

- Tipul vehiculului
- Modul de utilizare
- Temperatura medie de functionare (temperaturi extreme → ventilator sau incalzitor)
- Potentialul acumularii de gaze

9

2. Baterii acide cu plumb

2.1. Constructie



10

2.2. Caracteristicile bateriilor

Cat curent, cat timp?! ➔ viteza reactiei chimice ➔ aria suprafetei placilor
temperatura
densitatea electrolitului
curentul solicitat

Capacitatea C_{20} – Ah 44Ah = 2,2A x 20 h (U>=1.75V/celula = 10.5V)

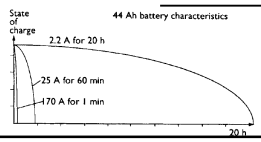
Capacitatea de rezerva RC – timpul [min] pt care I = 25A / 25ºC U>=1,75V (44 Ah ≅ 60 RC)

Capacitatea de pornire la rece CCA [A] – t [sec] -18ºC U>=7,2V

Standard	Time (seconds)
BS	60
DIN	30
SAE	30

Standard duty

Heavy duty (Ah, +RC +CCA)



11

2.2. Intretinere si incarcare

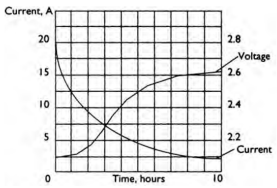
15000 raniti/an USA

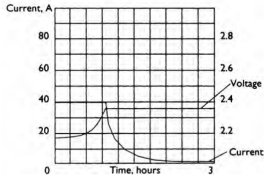
Maintenance
Low maintenance
Maintenance free

Apa distilata, stare curata, incarcare >70%, reincarcare 6 saptamani

U=ct. (14.4V t_{max} <=7h)
I=ct.
boost

Viteza incarcare=viteza descarcare 1/10 Ah; 1/16 RC; 1/40 CCA



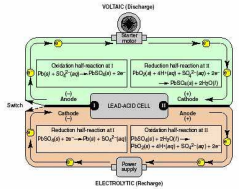


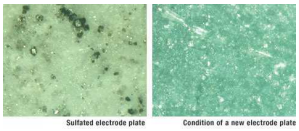
Incarcare rapida <5xI_n T<=43ºC (1h) ➔ 78-80% Ah

12

2.2. Electrochimie

Positive plates	$PbO_2 + 4H^+ + SO_4^{2-} + 2e \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} PbSO_4 + 2H_2O$
Negative plates	$Pb + SO_4^{2-} \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} PbSO_4 + 2e^-$
Over all reaction	$PbO_2 + Pb + 2H_2SO_4 \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} 2PbSO_4 + 2H_2O$

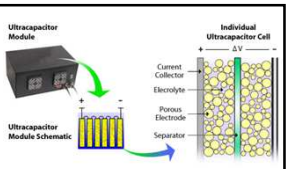


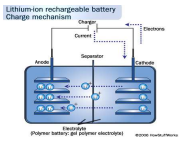


13

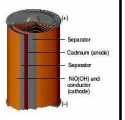
2.2. Stocarea energiei electrice

a) Pb acid
b) Alcalin
c) ZEBRA (zero emissions research activity)
d) Ultracondensatori
e) Celule de combustibil
f) NaS
g) Swing





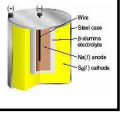
$Cd(s) + 2OH\text{-}(aq) \rightarrow Cd(OH)2(s) + 2e\text{-}$
$2NiO(OH)(s) + 2H2O(l) + 2e\text{-} \rightarrow 2Ni(OH)2(s) + 2OH\text{-}(aq)$



$(s) \rightarrow Li(in\ solid\ electrolyte) + e$
$lnO2(s) + Li + e \rightarrow LiMnO2(s)$

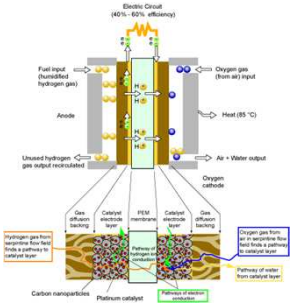


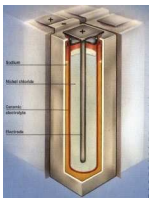
$2Na(l) \rightarrow 2Na(l) + 2e\text{-}$
$S8(l) + 2e\text{-} \rightarrow nS2(l)$

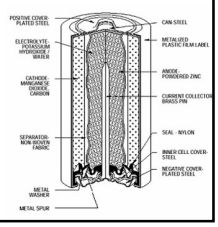


$4[Al(s) + 4OH\text{-}(aq) \rightarrow Al(OH)4\text{-}(aq) + 3e\text{-}]$
$3[O2(g) + 2H2O(l) + 4e \rightarrow 4OH\text{-}(aq)]$

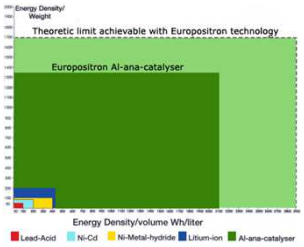
14







15



16

NO	Item	The limit Value	
		Backwed thickness(mm)	The limit value
1	Electrical resistanceΩ.dm²	≤0.30 ＞0.30~0.50 ＞0.50	≤0.0015 ≤0.0025 ≤0.0030
2	Tensile Strength Mpa	≥5.0	
3	Maximum pore sige μ m	≤25	
4	Porosity %	≥38	
5	Wettability S	≤5.0	
6	Weight loss pickled in acid %	≤2.0	
7	Foaming test	Foaming shouldn't cover all	
8	Potassium permanganate redacing substances ml/g	≤15	
9	Lron content %	≤0.04	
10	Free CL content %	≤0.003	
11	Moisture Content %	≤1.0	

Molecular formula:(CH22CCl)n
Appearance: Thin yellow sheet
Use: The storage battery manufacturing
Packing: sheet/carton/cartons

PVC separator is made of the special resin PVC and they are with excellent puncture resistance(>800g)、high melting point,low electrical resistance.The physical & chemical performance of our separators well situated for batteries and they are the reliable separators for kinds of Lead-Acid storage batteries.

17

Table 6: Energy Storage System Capacity Capital Costs[14 15 16 17 18 19 20 21 22]

Technology	Current Cost ($/kWh)	10-yr Projected Cost ($/kWh)
Flooded Lead-acid Batteries	$150	$150
VRLA Batteries	$200	$200
NiCd Batteries	$600	$600
Ni-MH Batteries	$800	$350
Li-ion Batteries	$1,333	$780
Na/S Batteries	$450	$350
Zebra Na/NiCl Batteries	$800 [1]	$150
Vanadium Redox Batteries	20 kWh=$1,800/kWh; 100 kWh =$600/kWh	25 kWh=$1,200/kWh 100 kWh=$500/kWh
Zn/Br Batteries	$500	$250/kWh plus $300/kW [2]
Lead-carbon Asymmetric Capacitors (hybrid)	$500	<$250
Low-speed Flywheels (steel)	$380	$300
High-speed Flywheels (composite)	$1,000	$800
Electrochemical Capacitors [3]	$356/kW	$250/kW

[1] €600/kWh
[2] The battery system includes an integrated PCS; the PCS price will vary with the rated system output.
[3] Electrochemical capacitors are power devices used only for short-duration applications. Consequently, their associated costs are shown in $/kW rather than $/kWh.

18

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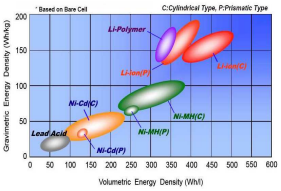
http://www.batteryuniversity.com/,
Battery University (cap.?, ☺ tot)

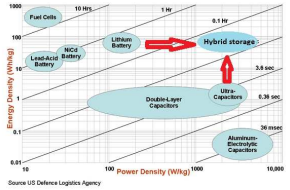
Regielive.ro, referate.ro ?! Curs EEEA Univ. Pitesti ☺☺☺
(cap. 3.1 Bateriile de acumulatoare)

Goagăl, Vichipedia şi altele utilizând cuvinte cheie corespunzătoare.

19

Comparison of Energy Density in Battery Cells
This battery comparison chart illustrates the volumetric and gravimetric energy densities based on bare battery cells.





Source:
http://cas2.umkc.edu/physics/caruso/research/advanced_energy_recovery.html

Photo Credit: NASA - National Aeronautics and Space Administration / http://www.epectec.com/batteries/cell-comparison.html

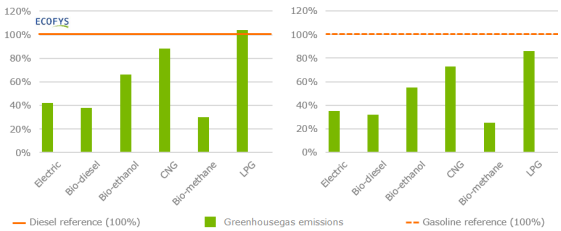
20

Specifications by Battery Chemistry (http://www.epectec.com/batteries/cell-comparison.html)

Specifications	Lead Acid	NiCd	NiMH	Li-ion Cobalt	Li-ion Manganese	Li-ion Phosphate
Specific Energy Density (Wh/kg)	30-50	45-80	60-120	150-190	100-135	90-120
Internal Resistance (mΩ)	<100 12V pack	100-200 6V pack	200-300 6V pack	150-300 7.2V	25-75 per cell	25-50 per cell
Life Cycle (80% discharge)	200-300	1000	300-500	500-1,000	500-1,000	1,000-2,000
Fast-Charge Time	8-16h	1h typical	2-4h	2-4h	1h or less	1h or less
Overcharge Tolerance	High	Moderate	Low	Low. Cannot tolerate trickle charge		
Self-Discharge/month (room temp)	5%	20%	30%	<10%		
Cell Voltage (nominal)	2V	1.2V	1.2V	3.6V	3.8V	3.3V
Charge Cutoff Voltage (V/cell)	2.40 Float 2.25	Full charge detection by voltage signature		4.20		3.60
Discharge Cutoff Voltage (V/cell, 1C)	1.75	1.00		2.50-3.00		2.80
Peak Load Current Best Result	5C 0.2C	20C 1C	5C 0.5C	>3C <1C	>30C <10C	>30C <10C
Charge Temperature	-20 to 50°C -4 to 122°F	0 to 45°C 32 to 113°F		0 to 45°C 32 to 113°F		
Discharge Temperature	-20 to 50°C -4 to 122°F	-20 to 65°C -4 to 149°F		-20 to 60°C -4 to 140°F		
Maintenance Requirement	3-6 Months (topping charge)	30-60 days (discharge)	60-90 days (discharge)	Not required		
Safety Requirements	Thermally stable	Thermally stable, fuse protection common		Protection circuit mandatory		
In Use Since	Late 1800s	1950	1990	1991	1996	1999
Toxicity	Very High	Very High	Low		Low	

21

Alternative fuels and infrastructure in seven non-EU markets - Final report



Well to Wheel greenhouse gas emissions for different fuel types for passenger cars relative to diesel (left) and gasoline (right), using current average emission factors (source: www.fuelswitch.nl compiled from many sources from 2002-2011)

22