

ENVIRONMENT-COMPATIBLE AND PEOPLE-FRIENDLY RAILWAY

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1. Introduction

Railway as one of the most environment-friendly transport modes is now more than ever ready to use this advantage for the future solutions of transportation problem. One could easily say that this advantage is becoming more like obligation because environmental crisis is already visible on every step of our lives. Crises are here, times are hard, but this is not the time to give up. We must bear in mind that crises are not endless when on the other hand opportunities and ideas are.

2. Key words

Environment, crisis, power storage, fuel cells, pollution

3. Definition of the problem and goal

In this article we will focus on possibilities of energy-recycling rolling stock where kinetic energy of the moving train can be recycled while braking and used as recycled energy for passive track-side applications. We will briefly mention highly energy-efficient synchronous motors with permanent magnets and we will also discuss ways and possibilities of power storage today. One of very interesting technologies for power storage today is double layer capacitor technology which is used for voltage drops compensations in DC feeding currents. We

will try to catch a glimpse of the future too as we will briefly describe what is currently being done in the field of fuel-cells driven rolling stock, which is another approach for combating environmental crisis in the future

4. Store It!

One of the most exciting facts of the moving things is that they need energy to stop as well as they need it to move (relatively speaking, of course). The greenest and the cleanest way would be recycling of otherwise useless breaking energy which is the energy needed for an object to stop relative to the certain point in space. There are some quite interesting ideas that are already in use as well as some ideas that still seem to come from a distant future.

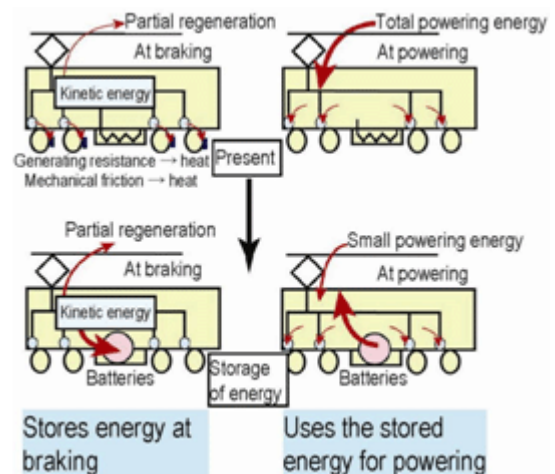
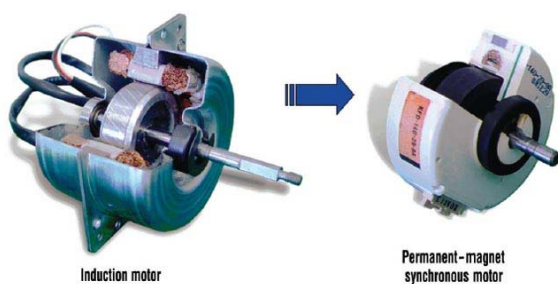


Image 1: Possibilities of using braking energy

From the railway aspect there are also some approaches on how to use recyclable energy. It can be returned back to the electric network or it can be stored locally on the on-board rechargeable cells (lithium-ion batteries are one of the options available at this time). Although the production of such cells is environmentally controversial, it is on the other hand much friendlier to the environment opposed to conventional braking systems which do not use any of the braking energy (so they need to consume more of the fossil-fueled one). More power and friction is also needed (braking plates also emit dangerous particles into the environment). Not to mention that boosting energy storage production would also cause these products to be cleaner, safer and at the same time cheaper.

5. Optimize It!

If ambitious and futuristic energy saving projects are too far in the future for your thinking, there is still a lot you can do in the present.



1. The latest permanent-magnet motors are 30% smaller and 10% to 15% more efficient than equivalently rated induction motors. Recent advances in manufacturing, including embedding the permanent magnets radially in the rotor rather than tangentially around the rim, have made their performance even more attractive.

Image 2: Permanent magnet motor

Optimize conventional methods, systems and technologies to get the best out of them while at the same time lowering your share of the burden to the environment as much as possible.

One of such brilliant ideas is permanent magnet synchronous motor which is used

for conventional trains. These types of motors are more efficient, they save energy, they are more noise friendly and not to mention lower maintenance costs. For example, there is no motor brush wear and therefore high reliability at very high rotation speeds is achieved. There is very smooth rotation and no ripples of the torque. These motors are very accurate and are also very useful for position control.

Practically anyone of us is striving to reduce costs. Wouldn't it be great if you would grip these cost reductions from more innovative perspective and even get benefits of it?

6. Noise can pollute too

Noise is one of the factors that didn't get so much attention in the past years as it should. While we invested tremendous amounts of knowledge and money into noise reduction for us, people, we mostly forgot about noise reduction effects to the environment.



Image 3: Y-shaped noise reduction fence

The whole natural feeding chains are being interrupted or even broken due to roaring highways, motorways, airports and railways and effects of it are visible in time and space that we live in. It is eventually all coming back to us. We can't simply stop, that is the reality, but we can improve a lot of things. We already mentioned more

silent motors. There is also great progress being made with noise barriers which could easily be used in environmentally sensitive areas which include much more than urban areas. A simple Y-shaped solution for example showed very good performance and effect to the noise reduction. And the idea was ingeniously simple. As simple as many other ideas still waiting to be discovered.

7. Hydrogen power

Hydrogen is the most abundant chemical element, constituting roughly 75% of the universe's elemental mass. For most of us fuel cells, that exploit the power of hydrogen, seemed almost like science fiction or multi-billion dollar story from NASA space agency not just long ago. But if fuel cells powered most of the lunar landings back in 1969-1972, it is easy to figure it out that this technology is not new and that it had over 30 years of development behind. Fuel cells in the railway networks and companies are mostly being considered as the replacement of diesel cars used on non-electrified sections of railway today.

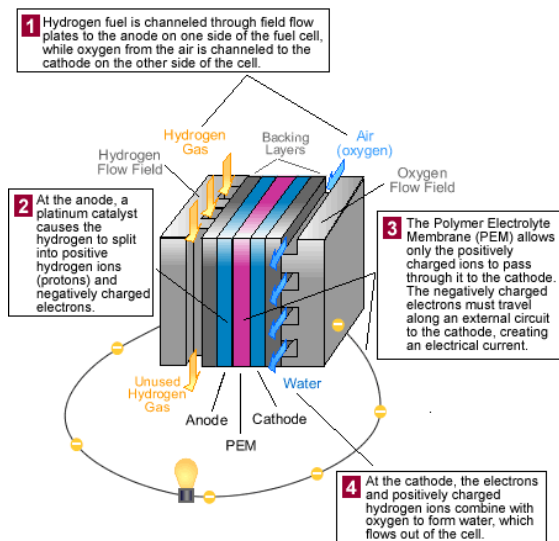


Image 4: Principle of fuel cell

Fuel cells today represent the most promising alternative to the internal combustion engines. Electro-chemical processes produce electric power and heat, leaving nothing but pure water as the byproduct. Oxygen for fuel cells is extracted from air (atmosphere) while hydrogen needs to be produced (by electrolysis from plain water or by extracting hydrogen from fossil and renewable hydrocarbon fuels).

On October 19, 2006 East Japan Railway Company tested a fuel cell powered train, the first fuel cell hybrid train which used two 65kW fuel cells and reached maximum speed of 100km/h and 50-100km range without refueling of hydrogen.

8. Wind and solar power

Most of us don't actually realize how vast and huge solar energy resources are. The amount of solar energy that reaches the surface of our planet in just one year is twice (2x!) as high as all the energy of non-renewable resources from earth that will ever be obtained and that includes coal, oil, natural gas and mined uranium together.



Image 5: Solar roofing on the conventional passenger cart.

If we manage to "catch" and use merely a fraction of solar energy, energy crisis of

our days would become a history book theme. Wind energy is another interesting source and it is somehow related to sun energy source as the sun influences weather and atmospheric currents. From the railway aspect there is already some progress being made in using solar power (for track side applications; powering signals, charging batteries etc.) but it is still pretty unexploited on the rolling stock side. Solar panels mounted on trains could significantly reduce the need of external power consumption. In combination with fuel cells, braking power storage and with innovative superconducting traction transformers we can really make a huge step forward.

http://en.wikipedia.org/wiki/Solar_energy

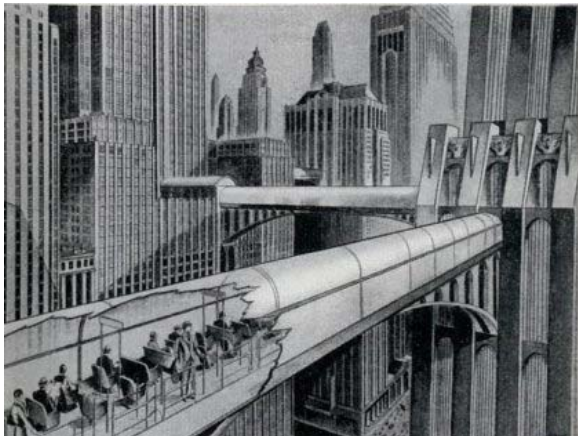


Image 6: Railways of the future may not look like that on the picture, but even thinking about future is better than doing nothing at all.

9. Conclusion

One does not need to become a rocket scientist to realize that renewable energy sources are far from being exhausted. The problem is that the mankind in the past (since industrial revolution) paid too much attention in exploiting and discovering non-renewable fossil fuels while in most cases putting aside renewable resources. Things are changing, unfortunately also because of environmental changes and influences of fossil fuels to the

environment. Railway is on the good path towards renewable energy exploitation, but it still needs some changes in thinking. The key may be in continuance of traditionally reliable railways combined with switching to renewable energy sources and energy saving technologies. Renewable energy is everywhere. We just need to learn how to use it.

10. Literature

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