

Regenerative braking in Siemens EMU

N.D.Turkar/PL/IRIEEN/NK

Principle of operation of dynamic braking

1. During braking, The rolling wheels turn the TM rotor and when synchronous speed of traction motor reduces below rotor speed by reducing frequency, the motor acts as generator and Kinetic energy is converted in to electrical energy.
2. During dynamic braking, negative torque is generated due negative slip. Contd...

Principle of operation of dynamic braking contd...

3. The traction motor which is now acting as a generator, are connected to Dynamic brake resistor or OHE which puts a large load on the electrical circuit.
4. When a generator circuit is loaded down with resistance or by feeding back to OHE, it causes the generators to resist rotation, thus slowing the train.

Rheostatic braking

1. The electrical energy produced by the motors is dissipated as heat by dynamic braking resistor.
2. Modern systems have thermal monitoring, so if the temperature of the bank becomes excessive, it will be switched off, and the braking will revert to pure friction mode.

Regenerative braking

1. Regenerative braking feeds the recovered energy back to the power supply instead of wasting it as a heat.
2. Electric trains normally incorporate both regenerative and rheostatic braking. If the power supply system is not "*receptive*" to the regenerated power, the system will default to rheostatic or mechanical friction braking.

Three Phase Technology

- Regenerative Braking

- 3 phase EMUs

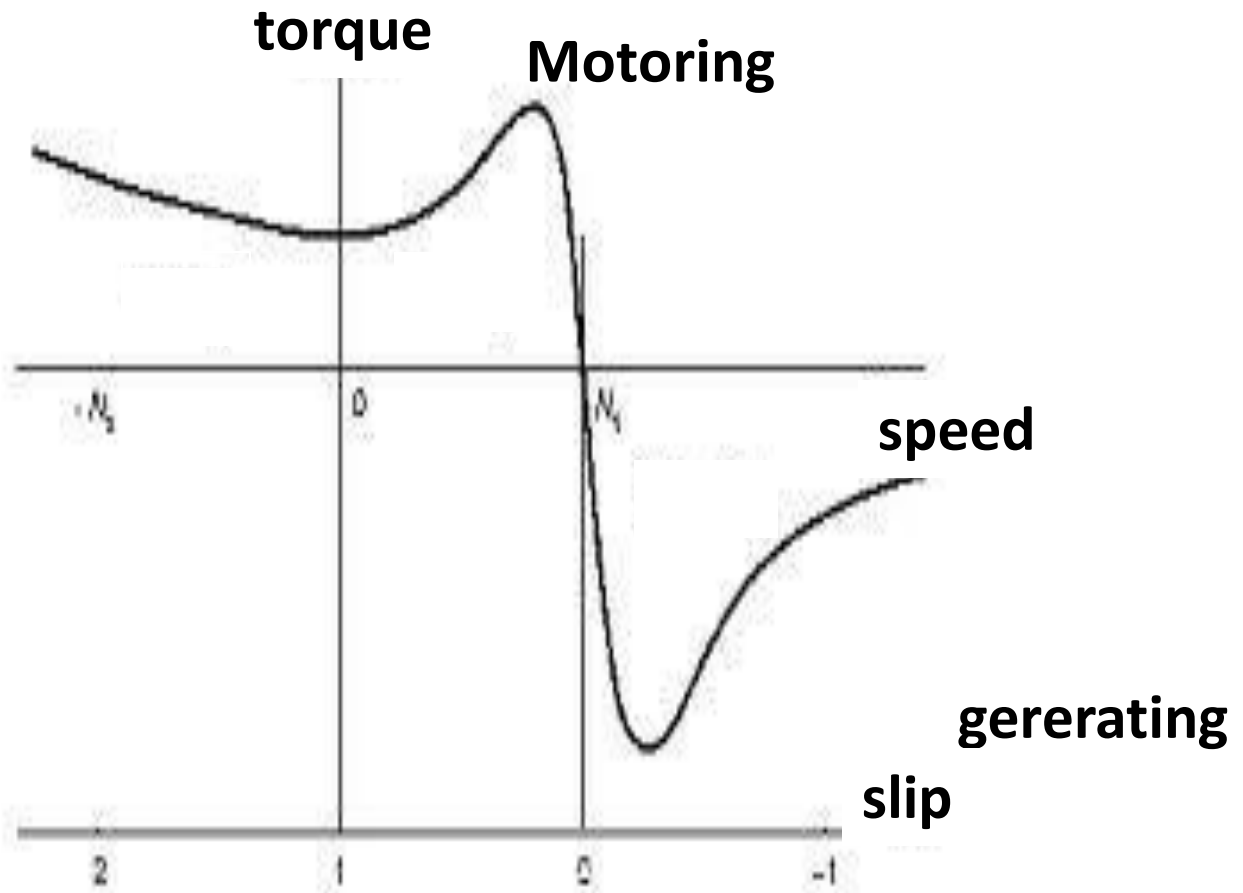
- Energy regenerated is 40% of energy consumed.

- Approx. saving of 78 lakhs per rake per year

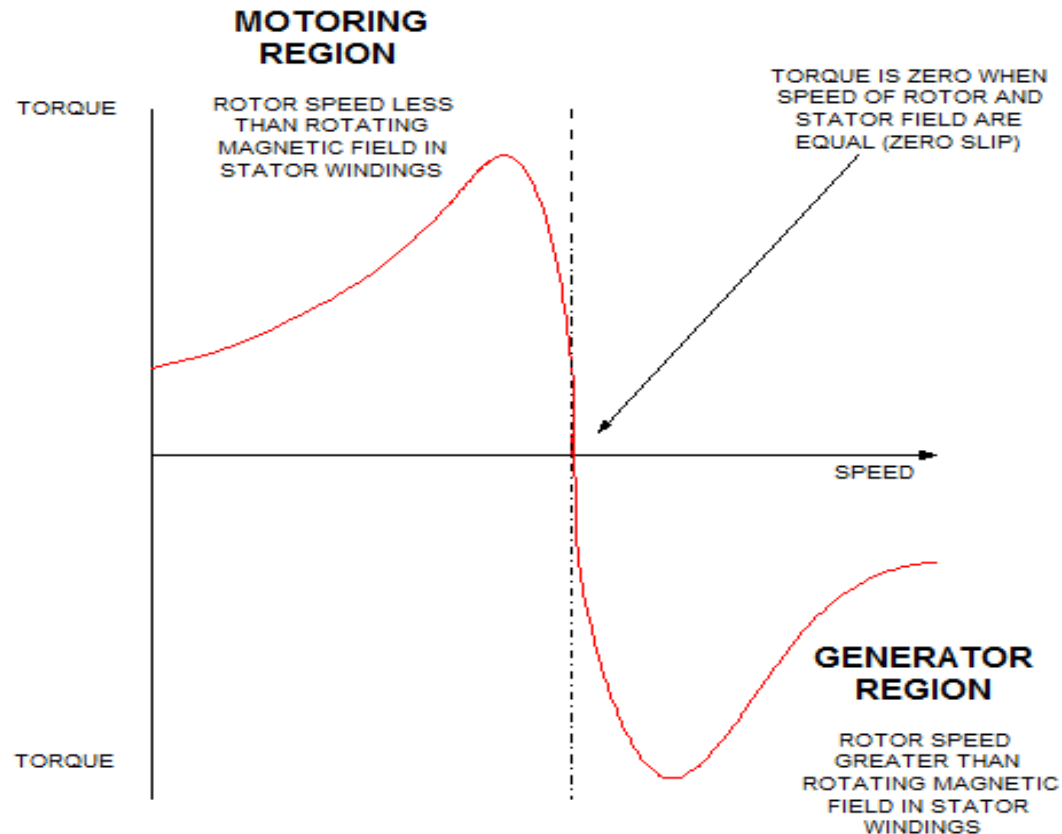
- 3 phase Locomotives

- Energy regenerated is 12% of energy consumed.

- Approx. saving of 23 lakhs per loco per year



Torque speed characteristic of 3 phase SCIM



3 Phase Induction Motor Characteristic

Brake system in Siemens EMU

1. In siemens EMU, the brake system consists of a fully integrated dynamic brake, either regenerative or rheostatic, and a pneumatic service brake.
 2. The dynamic brake is integrated into the main propulsion package.
 3. The pneumatic brake is a load variable fail safe air brake.
- Contd....

Contd.....

4. Priority is always given to the electric dynamic brake with air brake being used to supplement braking effort and provide failsafe conditions.
5. In the case of limited dynamic brake capability, emergencies or failures, a pneumatic friction brake is provided to operate the friction brakes. Contd...

Contd.....

6. The friction brake is also used during service braking to continuously blend with and supplement the electric brake.
7. In the event of a failure of the electric brake the friction brake is capable of accomplishing the full-specified braking duty.
8. The electric brake *is disabled during emergency brake applications.*

Brake Blending

- The control system for combining the friction and dynamic brakes is known as “Brake blending”.
- If the brake demand exceeds the dynamic brake capability, then the control equipment applies the friction brake, firstly to the trailer coach up to maximum braking level for that vehicle, then to the motor coach to supplement the dynamic brake.

Advantage of regenerative braking

1. Energy saving up to 30%.
2. It increases system efficiency and section capacity.
3. It reduces maintenance cost of brake blocks.
4. It reduces the wear and tear of wheel resulting in increase of wheel life.
5. It lowers the wear of friction-based braking components.
6. It reduces energy consumption.

Thanking You All

