The Haulers' Evolution

By **Malcolm Caron-Boivin***

There are many discussions within the industry regarding the restructuring and establishment of standards to promote the decarbonisation of aluminium production. Important initiatives are deployed to reduce the overall environmental footprint of the industry across the value chain and emerge from close collaboration between smelters, customers, suppliers, equipment manufacturers, employees, and the community.

The enthusiasm that comes with the industrial drive towards net-zero emissions goes to show that aluminium and equipment manufacturers have a pivotal role to play. This is why we, at EPIQ Machinery, decided to develop a new fully electrical motorisation for one of our existing MECFOR tractor model, the MTA30. Timing is right; this initiative is supported by our customers and governments and the prototype is already planned to be tested in real operation environment.

EPIQ MECFOR Diesel engine powered Anode hauler

Follow the 'green' brick road

The International Aluminium Institute identified three pathways to reduce greenhouse gas emissions (Aluminium Sector Greenhouse Gas Pathways to 2050, 2021):

1. Electricity decarbonisation by using clean energy instead of fossils fuels: The aluminum sector currently produces 1.1 billion tonnes of CO_2, and more than 60% of it is from the production of electricity consumed during the smelting process. The opportunity is big there.

2. Direct emissions potential: Emissions from fuel combustion make up 15% of the industry's emissions. A little bit less then the previous one, but still significant. Of course, this is exactly where the electrification of diesel solutions is going to help.

3. Recycling and resource efficiency: By increasing collection rates to near 100% as well as other resource efficiency progress by 2050 would reduce the need for primary aluminium by 20%.

Aluminium is turning green and big players are leading the way. Many of our customers have set ambitious goals to achieve net zero emissions by 2050. EPIQ MECFOR has chosen to embrace the challenge and is working in offering equipment to reduce direct emissions.

From Diesel to Electric Hauler

EPIQ MECFOR haulers are criss-crossing halls of primary aluminium smelters for more than 25 years, cumulating over 100,000 hours of operations.

With 100+ haulers in operation, hauling different types of trailers with the same attachment system, we figured that our customers already own a lot of spare parts for them, and not to mention that their teams of operators are well-trained making them extremely efficient and accustomed to the way it drives and the way it maneuvers.

Plus, our haulers have gone through several iterations based on customer's feedback and the expertise developed along the way. It was inconceivable for EPIQ MECFOR to start designing from scratch. That is why the decision was made to use the same overall design, so most components remain the same (cabin, frame, wheels, operation approach, etc.), except anything related to the motorisation. From the outside, it will be difficult to make the difference; the revolution is from the inside.

This approach will also allow our customers to perform the Anodes or Molten Metal crucibles hauling operations about the same. The vehicle will have the same dimensions and manoeuverability. Pick-up and drop off locations of the payloads can be kept the same. It is an articulated model, it can be coupled to any existing trailers, and future EPIQ MECFOR trailers can be built using the same design, no engineering needed to adapt.

In its portfolio, EPIQ MECFOR has two tractor designs: MTA (narrow) and MTC (large). The Engineering and Design team is currently designing the prototypes of

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the MTE – the electric version – based on the MTA30. The team has started to instrument existing vehicles that are in operation in customers' plants. Data is collected and analysed to determine the duty cycle of a hauler in operation. That way EPIQ MECFOR can make sure the tractor has the right autonomy and charging time to be integrated in a smelter's operation seamlessly.

Multifaceted challenges: two key elements to consider

There are multifaceted challenges to this decarbonisation process across all levels. The transition to 'green' energy Anode Haulers requires facility modifications (e.g.: charging station) along with new skills for maintenance teams. The same maintenance team that has been working with diesel fleets will now have to develop a brand-new expertise with electric vehicles: maintaining high voltage batteries, electric drives, charging stations, etc.

Hauling anodes may seem simple. However, when we take a closer look at the operating environment of aluminium producers, we quickly come to understand the complex challenges that comes with operating electrified haulers in this environment. The involvement and the cooperation of the end-users, aka the aluminium producers, is necessary.

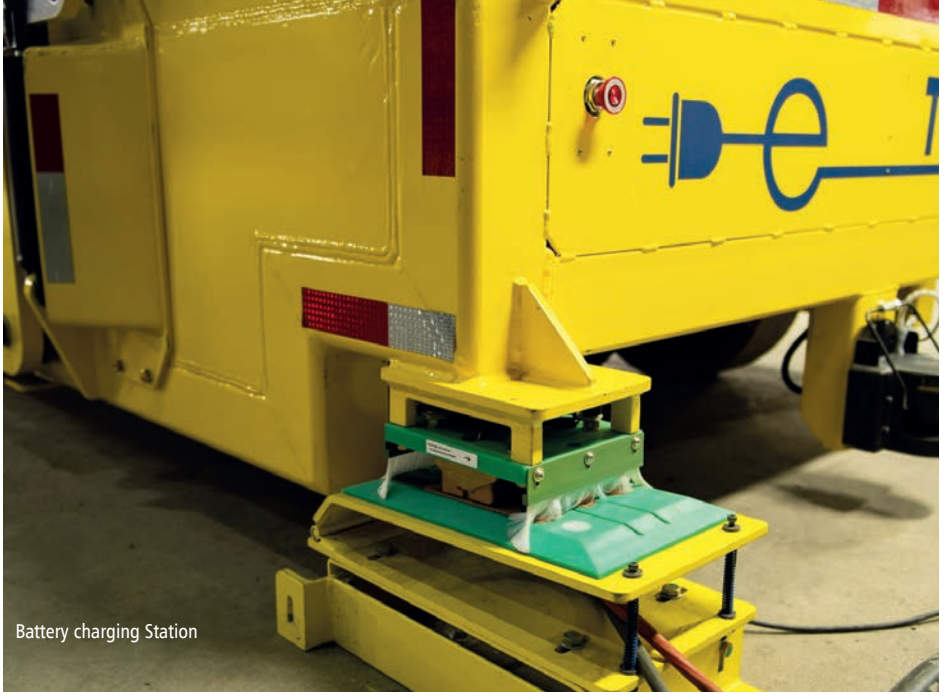
a. Analysis of vehicle usage

The first key element to consider is the analysis of vehicle usage. This is what we are doing at the moment by instrumenting existing vehicles. However, we cannot use that data for any plant, as every operation is different, from facility to facility, and even from an operator to another.

Type of driving. We have jacks on the articulation that provide steering to the vehicle. This can take a lot of energy. The way you drive, and steer can have a lot of impact on the autonomy.

Acceleration and deceleration. If you have an operator that tends to put the pedal to the floor every time he or she wants to move forward, that's going to affect and drain a lot more energy than a smooth ramp up. Speed management is important; when and where you are going to reach top speed, optimal speeds in function of distances to travel, etc.

Duty cycle in a shift. Several shifts need to be studied to provide the right solution and maintain the same operation as with a diesel fleet. Operators also need to be prepared to adapt the way they drive. Even with electric city buses, operators need to go to through a whole training to ensure vehicles are operated the same way by different operators. Instrumenting also allows to monitor and log the way it is being operated.


Battery charging Station

b. Analysis of work processes and practices

The second key element is the analysis of work processes and practices. A transition strategy needs to be defined to make sure it is seamless, and it doesn't impact production.

Choice of charging strategy; are we swapping battery packs, having a charger on board, chargers outboard? Where do you put the chargers to optimise operations, at pick-up and drop off locations? How many of them? When are you charging? This needs to be studied at the very beginning of the project and can all be simulated using real operational data from instrumented vehicles to ensure precise results.

Are we switching to a 100% electric haulers fleet or are we doing it gradually? A hybrid fleet might be a good approach for now until battery technology, which evolves extremely rapidly, improves.

Vehicle maintenance plan needs to be considered as it is very different than a diesel fleet: less maintenance, but a different type. Limitations due to space constraints, for charging stations and parking spots need to be well-thought.

The conversion goes further: from electric rigid hauler to AGV

Back in September 2022, EPIQ Machinery announced its partnership with DTA S.A., a Spanish company. DTA's core business is to deliver heavy-duty and tailored made AGV solutions. EPIQ, in cooperation with, is working on a non-articulated single-hulled electric model. This rigid design could be more easily converted later in AGVs. Our prognostic is that, once the transition to electric equipment is well underway, some producers will be ready to step up with auto guided haulers.

Based on what we've seen so far with AGVs in the aluminum industry, customers are not yet ready to go with a fully autonomous solution. The great thing about the rigid electric design is that it can be converted into an AGV later if wanted.

The cabin can be removed or not to maintain a hybrid operational mode during the transition. Being electric, it has low maintenance, longer lifetime, it is very compact and has innovative traction allowing more flexibility, multidirectional steering allowing crabbing (side movement), which offers great manoeuvrability in limited spaces.

EPIQ and DTA will deliver and put in operations their first rigid electric hauler project by end of this year.

Once the risks mitigated, the industry will be in a reassuring position to shift to full AGV solutions that will allow the optimisation of human resources, which are getting scarcer, towards value added tasks (less repetitive). Also, AGVs will enhance safety in harsh operation environments using natural navigation. This type of navigation prevents from extensive infrastructure modifications (wire, paint lines, heavy-maintenance reflectors, etc.) It is connected to a state-of-the-art fleet management which is fully integrated to the plant management system.

Today's talk of the town: Industry 4.0

All of this can be fully integrated to the whole 4.0 solution. EPIQ vehicles, autonomous or not, can-do real-time data gathering which includes but are not limited to localisation and traceability of the payload, fleet management, live monitoring of equipment health, predictive maintenance, etc.

The order management of the AGVs would be integrated to the plant control system (MES, ERP, etc.) allowing data gathering and management.

We can also imagine in a near future the ability to treat this data with AI to optimise production. In short, converting heavy-duty mobile equipment from diesel to electric is a step further to a new technological era. At EPIQ, we're in. ■