tial failure will result in diagnostic action which is a proactive activity and usually begins with a condition based maintenance process.

Also steps should be taken to manage any risks arising from maintenance activity. Manufacturer's instructions should make recommendations on how to safely undertake maintenance of their agricultural vehicles and, unless there are good reasons otherwise, these should always be followed. Always plan the job and use safe systems of work whether in the workshop or in the field [4].

The introduction of innovative technology has made a devastating impact on advanced facilities and maintenance management practices, inspiring some key promising maintenance trends likely to shift the industry as a whole in the coming years.

References

1.Bell, Brian. Farm Machinery (6th Edition) / Brian Bell. – Hardcover: Farming Press Limited, 2015. – 308 p.

2.Farm Machinery Repair and Maintenance – A Collection of Articles on Ploughs, Harrows, Drills and Other Farm Machines: Various / Marcel: Marcel Press, 2011. – 258 p.

3.General Maintenance Tips for Farm Equipment [Electronic resource]. – Mode of access: http://titanoutletstore.com/general-maintenance-tips-for-farm-equipment/. – Date of access: 16.04.2019.

4.Vehicle repair – Agriculture – HSE [Electronic resource]. – Mode of access: http://www.hse.gov.uk/agriculture/topics/maintenance-2.htm. – Date of access: 16.04.2019.

УДК 829.11 (075.8)

ELECTRIC TRACTOR

Students – Vasilchuk A., 22 mo, 2 year, TSF;
Zmushko R., 11 mpt, 1 year, AMF
Scientific supervisor – Misiuk S., senior teacher
EI «Belarusian State Agrarian Technical University»,
Minsk, the Republic of Belarus

Abstract. Electric tractor technology offers greater fuel efficiency and reduced emissions. Because of electric motors, tractors have extensive operational life spans. They also have minimal service requirements.

Keywords: tractor, fuel, gasoline, transmission, battery, engine, torque, soil compaction, electric powered robotic platforms, emission, electric motor, line extension, power take-off, speed ratio, spray gun.

Advances in technology and farming practices have helped farmers become much more productive, growing crops efficiently in areas most suitable for agricultural production. Using electric motors in agriculture can help increase efficiency and save the environment. The aim of this research is to determine advantages and disadvantages of electric tractors.

Traditional tractors are powered by engines fueled by either diesel or gasoline and have transmissions powered with hydraulic fluids. But electric tractors are different. They are powered by a series of electric batteries that can be recharged simply by plugging them in to a standard socket. Electric motors have other advantages too. They are quieter and have the potential to produce more torque than internal combustion engines.

Farmers with electric tractors can install wind or solar power to produce the electricity to charge the tractor's battery. If their farm is on a hilly piece of land with a stream, they can even install a water-driven turbine to create electricity.

Tractors that run off electrical batteries require no fluids, which means an end to filling fuel tanks, checking oil, adding hydraulic fuel or changing filters [1].

With far fewer moving motorized parts than a traditional tractor, the electric machines can outlive their gas and diesel-fueled counterparts and are far less expensive to maintain.

Most diesel tractors need a complete engine rebuild after 6,000-hours of operation. That can be almost as expensive as a new tractor, but the electric tractors can work 5–10 years and all they may need is a battery change and anyone can do that themselves [1].

The proliferation of electric motors and actuators in applications ranging from industrial processes to modern passenger aircraft and cars is indicative of the drive away from mechanical traction and actuation systems to electrically based systems.

Large diesel vehicles are likely to remain in practical use for many years to come, however the optimum use of such vehicles has been to go as large as possible, which in itself leads to issues such as soil compaction and «brute force» delivery of fertilizer's, herbicides and pesticides. The migration from monolithic, fossil-fuel-based agricultural platforms to fleets of smaller electric powered robotic platforms offers the possibility of much lower emissions with locally generated power [2].

Recent years have seen an increase in the use of agricultural land for solar photovoltaic, wind turbines and anaerobic digestion plants. Therefore, the potential for dual use of not only the land, but also the electricity generated, is of interest to the agricultural robotics community. Many agricultural implements are driven directly from the prime mover (often a tractor) via a mechanical linkage. By using electric drives the efficiency can be much higher and the whole system made safer as a result. One of the most common sources of injury and death on the farm is the mechanical linkages in large farm machinery. Therefore there are potentially major health and safety benefits to electrification and automation of farm equipment.

One of the primary reasons for the introduction of electric tractor into the market is the concern over greenhouse gas emissions and their contribution to global warming. The purpose of creating electric motor that reduced or eliminated exhaust emissions was to help combat this issue. The greatest impact of reduced carbon emissions is in urban areas, where millions of people drive cars [2].

Decreased air pollution due to the elimination of the exhaust pipe in electric tractor promotes sustainable mobility. This in turn greatly reduces the negative impact of transportation needs on the atmosphere. In addition, even if all the electricity fuelling an electric tractor is produced using fossil fuels, it will still be less polluting than a gas car.

Among the advantages of electric motors are low power cost and long life. Because of electric motors, tractors have extensive operational life spans. For instance, an electric motor is selected and it offers up to 30,000 hours of life. (This is the approximate equivalent of 3½ years of perpetual usage.)They also have minimal service requirements. Electric motors are highly-efficient with ratings from 50 % to 95 % (depending on motor vehicle size and operating conditions). Automatic control and remote control functions are provided [2].

There are some disadvantages of electric motors: they need charging and expensive line extensions are sometimes required. Also speed-controlled motors are rather costly and require intricate special equipment that often complicates the installation.

An example is a tractor from John Deere SESAM.

John Deere's concept tractor borrows from Tesla's playbook – a simple battery back and electric motor direct drive. The tractor, called Sustainable Energy Supply for Agricultural Machinery (SESAM), is powered by a 130kWh lithium-ion battery pack. Deere adds a second motor to the power take-off (PTO). Total horsepower is around 400[3].

The tractor is a component of the autonomous farm of the future. In standard mode, it is used for the pto and auxiliary systems. If necessary, it can be used for both the motor vehicle and the hydraulic work. The tractor runs at the lowest possible noise levels, where it is possible to work at night. The battery can provide 4-5 hours of power when fully charged, and then during lunch, it can be supercharged before working for another spell in the afternoon. Charging normally takes five hours, but there is a supercharge option that tops up 80 % in 40 minutes. The battery is designed to last for 3100 charging cycles [3].

There is no need for a spray gun. Uniquely featuring two electrically-operated liquid valves, it has been designed to fully reduce the flow rate. It is able to control the flow rate. Forwarding speed is from 10 to 30 kph for a constant spraying pressure, or for varying output from 100 to 300 liters / ha for a constant spraying speed. In addition, it is possible to reduce the flow of water [3].

Regenerative braking, which will work automatically on downhill slopes, feeds power back into the SESAM tractor's battery to give it additional range. ExactApply also increases application when spraying in curves. It can be adjusted automatically. Research shows that it is necessary to improve the light. This makes it no longer necessary for the operator [3].

The new development is a permanent magnet electric motor system that achieves a 10-to-1 top speed to base speed ratio, or what is commonly referred to in the industry as constant power speed ratio (CPSR). This provides both high-

torque and high-speed capability in the same machine at levels greater than twice that of the electric motor industry's best-performing motor technology.

Electric motor technology is an exciting breakthrough, though it is an advanced engineering project that might not result in a marketable product for 10 years. But it is the future of agriculture as electric motor technology offers the prospect of greater fuel efficiency and reduced emissions. In spite of challenges, this concept deserves more press. The farm of the future will be a self-sustaining energy system, creating energy from wind, solar, and anaerobic digesters, and storing such energy in batteries on the farm. And that's why Deere's all-electric concept is potentially a breakthrough. Farms will someday become energy producers in much the same way they produce food. Having a farm vehicle that can do the work and be powered by on-farm energy sources helps get us to that holy grail in farming – sustainability.

References

1.Advantages of electric tractor [Electronic resource]. – Mode of access: https://*www.*cleantechnica.com/.../ Advantages of electric tractor... – Date of access: 21.03.2019.

2. Electric tractor [Electronic resource]. – Mode of access: https:// www.farmprogress.com/*tractors/* Electric tractor... – Date of access: 23.03.2019.

3. John Deere SESAM electric tractor [Electronic resource]. – Mode of access: https:// www.deere.com/science/.../pdf... – Date of access: 28.03.2019.

UDC 631.171 (075.8)

ARTIFICIAL INTELLIGENCE IN AGRICULTURE

Students – Voyteshonok V., 22 mo, 2 year, TSF;
Silivonchik V., 11 mpt, 1 year, AMF
Scientific supervisor – Misiuk S.V., senior teacher
EI «Belarusian State Agrarian Technical University», Minsk, the Republic of Belarus

Abstract. Artificial Intelligence-driven technologies are emerging to help improve efficiency and to address challenges facing agriculture. Agricultural robots are poised to become a highly valued application of AI in this sector.

Keywords: Artificial Intelligence, automation, autonomous tractor, human-operated tractor, robotic equipment, digital agriculture, soft robotics, combine harvester, collision, self-driving tractor, crop yield.

New agricultural technologies and techniques have staved off the sharp famines. Though once humans had to plant seeds haphazardly by hand, seed drills enabled farmers to sow them in long, uniform lines. With steam-powered tractors, farmers could plow wide swaths of land, without the need for sluggish oxen. Threshing machines cut down the many hours devoted to threshing by hand.