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ANALYSIS OF SCHEDULE AND EXECUTION OF TECHNICAL INSPECTIONS OF AGRICULTURAL TRACTORS

ANALIZA HARMONOGRAMU I SPOSOBU REALIZACJI
PRZEGLĄDÓW TECHNICZNYCH CIĄGNIKÓW ROLNICZYCH

Summary

Technical servicing is an integral element in the operation system of tractors and other agricultural machines. Servicing processes include mainly operations performed within the framework of scheduled periodical technical inspections, which objective is to ensure operability of technical objects and maximum extension of their failure-free operation. The aim of this study was to collect data on the execution of technical servicing for agricultural tractors used on family farms and to determine their proper scheduling. Analyses were conducted using a questionnaire distributed among farmers from the Wielkopolskie province. This study showed that most farmers perform technical servicing of tractors on farms, thus ignoring the schedule for the execution of technical inspections specified in the vehicle manual.

Key words: servicing of machines, agricultural tractor

Introduction

Agricultural machines are technical objects, characterised by considerable variability in comparison to other machines. They need to meet numerous requirements, resulting from the unique character of agricultural production, which rhythmicality is connected with climatic and weather conditions (Osuch et al., 2015b; Rybacki and Durczak, 2011). Operation of agricultural machines comprises several processes performed by machine operators. It is composed of a set of relationships between technical objects and their users from the time of machine purchase to its sale or disposal. Operating processes include machine usage, operation and supply with materials and parts (Buchwald et al.,

2015; Rzeźnik, 2008). In practice technical operation of agricultural machines is referred to as technical servicing, which objective is to ensure operability of technical objects. Technical inspections are the primary processes within the technical servicing systems for agricultural tractors (Rybacki, 2009; Rybacki and Durczak, 2011, 2012; Rzeźnik, 2008; Tomczyk, 2009). Inspections of agricultural vehicles should be performed after service life periods specified by the manufacturer, while the length of guaranteed failure-free operation at properly selected consumables is defined by the number of engine hours. Tractors on farms are used with varying intensity in successive months of the year, thus making it difficult to precisely forecast demand for servicing operations of servicing stations. The number of tractors covered by warranty servicing is known; however, it is not possible to precisely specify the schedule for executed technical inspections. It is especially difficult to estimate the number of post-warranty inspections (Juściński and Piekarski, 2008, 2009; Juściński and Szczepanik, 2008). Maintenance of operability in the case of agricultural tractors is a complex process due to their unique working conditions. The primary task is to timely perform operations connected with replacement of consumables, to counter destructive processes characteristic of agricultural machines, i.e. ageing and wear (Buchwald and Staszak, 2013; Grądkowski et al., 1999; Rzeźnik, 2008). Inadequate operation of agricultural machines by delaying the execution of servicing operations and replacement of suitable consumables with substitute materials may result in an undesirable failure of the machine (Buchwald and Staszak, 2013; Jóska and Kołodziejwski, 2008). In agricultural tractors servicing processes include mainly prevention operations. The most frequently executed operations are supplementation and replacement of operating fluids as well as lubrication and regulation of mechanisms, accounting for over 80% all performed servicing operations (Buchwald and Staszak, 2013; Buchwald et al., 2015). Prevention of failure and wear in machine maintenance processes is frequently inadequate. It results both from the insufficient knowledge on the principles of maintenance processes for agricultural machines and the intention to minimise the share of technical servicing costs in expenses incurred by farmers (Skrobacki and Ekielski, 2006). Users of agricultural machines frequently try to extend the periods between technical inspections, while also tending to search for substitute consumables (Buchwald and Staszak, 2013). Substitute consumables are often inadequate and frequently do not meet the specifications of agricultural machines. Farmers, willing to maximally reduce maintenance costs of their agricultural machines, particularly older or past their warranty period, often perform servicing operations themselves. It needs to be stressed that typically farmers are not experts and do not have the required specialist knowledge on machine servicing, thus they gain experience based on the trial-and-error method when executing technical servicing operations. Errors in technical servicing of agricultural machines, particularly engine-powered, may lead to accelerated wear to failure of subassemblies, which in turn may result in high costs of required damage repairs. Analyses were conducted for servicing of agricultural tractors on family farms in the Wielkopolskie province. This study may prove useful in the adaptation of servicing stations to customised requirements of individual users of engine-powered agricultural machines. Well-executed processes of technical servicing in the case of tractors and other agricultural machines facilitate their potential efficient use, which directly influences the economic results of farms.

Material and methods

The aim of this study was to analyse the observation of schedules of technical inspections for agricultural tractors and to identify approaches to their execution. Analysis of the collected data made it possible to determine the current situation in servicing of agricultural machines, particularly agricultural tractors. This paper presents the developed multiple criterion questionnaire as well as a list and an analysis of results, which made it possible to formulate conclusions. The questionnaires were sent to owners of family farms in the Wielkopolskie province. The survey was conducted in 2015 in around a dozen of farms, in which farmers used a total of 31 agricultural tractors of various makes, differing in their horse power and in the length of their service life. Respondents answered questions concerning technical servicing of owned agricultural tractors – their course or the intervals between technical inspections, execution of technical servicing (authorised servicing stations, local servicing stations or on the farm), while they also specified the make and model of the tractor as well as their horse power and year of production. Based on the analysis of the results the actual condition was assessed, resulting from the observation of the technical servicing schedule.

Results and discussion

Farmers running family farms typically use tractors of two makes – Ursus and Zetor, although Massey Fergusons are also common. They are tractors, which service periods exceed 20 years. Table 1 presents all analysed agricultural tractors.

Table 1. Summary of tractors analysed
Tabela 1. Zestawienie ciągników poddanych analizie

No. Lp.	Make Marka	Model Model	Year of production Rok produkcji	Power Moc (kW)	Frequency of technical inspections Częstość przeglądów technicznych	Execution of technical inspections Sposób wykonywania przeglądów technicznych
1	2	3	4	5	6	7
1	Zetor	7711	1990	53.69	Once a year Raz w roku	On farm We własnym zakresie
2	Claas	Celtis 426	2007	52.96	300 mth	On farm We własnym zakresie
3	Massey Ferguson	5410	2012	55.16	300 mth	Local servicing station Serwis lokalny
4	Fendt	108 LS	1980	55.16	250 mth	On farm We własnym zakresie
5	Zetor	7745	1991	53.69	Once a year Raz w roku	Local servicing station Serwis lokalny

Table 1 – cont. / Tabela 1 – cd.

1	2	3	4	5	6	7
6	Zetor	7211	1987	48.54	Once a year Raz w roku	On farm We własnym zakresie
7	Fendt	305 LS	1983	45.60	Once a year Raz w roku	On farm We własnym zakresie
8	Zetor	7011	1982	47.81	Once a year Raz w roku	On farm We własnym zakresie
9	Massey Ferguson	6110	1995	52.22	350 mth	On farm We własnym zakresie
10	Kubota	M 6060	2014	48.54	400 mth	Authorised servicing station Serwis autoryzowany
11	Massey Ferguson	6120	1996	58.84	Once a year Raz w roku	On farm We własnym zakresie
12	Case	Puma 145	2015	107.38	400 mth	Authorised servicing station Serwis autoryzowany
13	Zetor	6245	1991	44.87	200 mth	On farm We własnym zakresie
14	Ursus	C-355	1972	33.10	Once in two years Raz na dwa lata	On farm We własnym zakresie
15	Massey Ferguson	3050	1992	52.22	250 mth	On farm We własnym zakresie
16	New Holland	TD 85D	2003	61.78	300 mth	On farm We własnym zakresie
17	Zetor	6340	1996	53.69	250 mth	Local servicing station Serwis lokalny
18	Ursus	C-330	1975	22.06	Once a year Raz w roku	On farm We własnym zakresie
19	Ursus	C-360	1988	34.57	Once in two years Raz na dwa lata	Local servicing station Serwis lokalny
20	Claas	Celtis 456	2008	74.29	300 mth	On farm We własnym zakresie
21	Fendt	312	2011	91.94	300 mth	Local servicing station Serwis lokalny
22	Ursus	C-4011	1968	33.10	Once a year Raz w roku	On farm We własnym zakresie
23	Ursus	C-330	1983	22.06	Once in two years Raz na dwa lata	On farm We własnym zakresie
24	Ursus	C-360	1992	34.57	Once a year Raz w roku	On farm We własnym zakresie

Table 1 – cont. / Tabela 1 – cd.

1	2	3	4	5	6	7
25	Massey Ferguson	5465	2012	97.09	400 mth	Local servicing station Serwis lokalny
26	Ursus	C-330	1980	22.06	Once a year Raz w roku	On farm We własnym zakresie
27	Ursus	C-360	1983	38.25	Once in two years Raz na dwa lata	On farm We własnym zakresie
28	New Holland	TS 100A	2005	74.29	350 mth	On farm We własnym zakresie
29	Ursus	C-330	1985	22.06	Once a year Raz w roku	On farm We własnym zakresie
30	Ursus	C-360	1980	38.25	Once a year Raz w roku	On farm We własnym zakresie
31	John Deere	6105M	2014	77.23	400 mth	Authorised servicing station Serwis autoryzowany

The execution of technical inspections on family farms is typically dependent on the age of tractors. During the warranty period guaranteed by the manufacturer (or the warranty extended by the dealer) agricultural machines are serviced in authorised servicing stations. The length of the warranty period depends on the tractor manufacturer and ranges from 12 to 60 months. The average age of analysed tractors is over 22 years, which greatly exceeds the average age of tractors in Poland, which according to Durczak (2011) and Osuch et al. (2015a) is over 17 years. Tractors varied in terms of the horse power generated by the engine, with the weakest tractor of 22 kW horse power and the strongest of 107 kW. The mean horse power of tractors was slightly below 52 kW. Analyses showed that farmers do not observe the technical inspection schedules for agricultural tractors, specified in the manual based on the number of running engine hours or the maximum operating period (unless the manual specifies otherwise, 1-year intervals or 300 running engine hours are assumed between replacement of consumables, whichever comes first). As it was shown in Figure 1, over 50% respondents declared that technical inspections are performed in 1- or 2-year intervals, regardless of the number of machine hours.

In the course of this study farmers declared three methods of technical inspection execution, i.e. the authorised servicing station, a local servicing station or by themselves on the farm. Farmers use authorised servicing stations only for tractors covered by the warranty, while they use local servicing stations typically for tractors aged max. 5 years, with some exceptions to that rule (e.g. Ursus C-360 produced in 1988). Respondents declared that they perform over 70% technical inspections themselves and that it is in order to minimise costs connected with machine operation. Detailed data are given in Figure 2. The above statement indicates that farms in Poland do not have adequate financial resources, which is confirmed by Skrobacki and Ekielski (2006), Buchwald and Staszak (2013) as well as Osuch et al. (2015a).

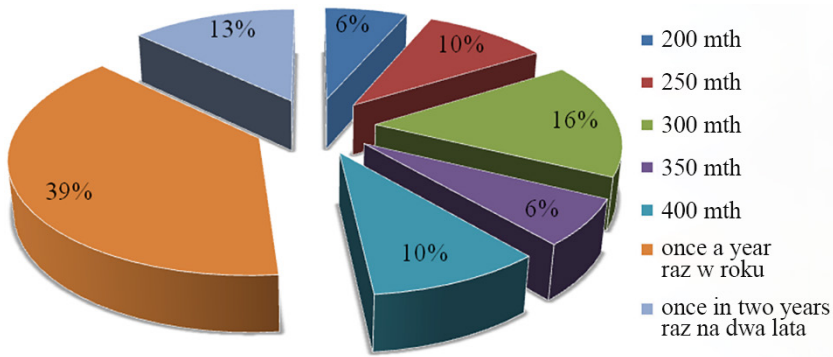


Fig. 1. Schedule for executed technical inspections
Rys. 1. Realizacja harmonogramu przeglądów technicznych

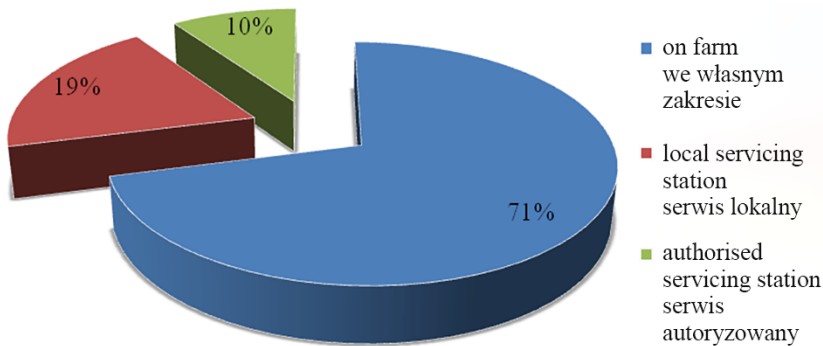


Fig. 2. Execution of technical inspections
Rys. 2. Sposoby realizacji przeglądów technicznych

Conclusions

1. After the expiry of service periods covered by the warranty of agricultural tractors farmers perform technical inspections themselves. This obviously results from limited profitability of farms; however, inadequate knowledge on machine servicing may frequently contribute to numerous errors made during technical servicing, as a consequence potentially leading to accelerated wear of subassemblies or wear to failure.

2. Farmers frequently ignore the technical servicing schedule specified in the manuals of agricultural tractors, performing inspections at extended intervals, which may result in excessive wear of subassemblies and lead to wear to failure of the machine.

3. Farms in Poland are underfinanced, as indicated by the age of used tractors.

References

- Buchwald, T., Rzeźnik, Cz., Staszak, Ż., Osuch, A. (2015). Sposoby zagospodarowania zużytych olejów eksploatacyjnych w zakładach serwisowych ciągników rolniczych. *Nauka Przym. Technol.*, 9, 4, #53. DOI: 10.17306/J.NPT.2015.4.53
- Buchwald, T., Staszak, Ż. (2013). Analiza realizacji przeglądów technicznych ciągników rolniczych. *Inż. Roln.*, 146, 3, 47–55.
- Durczak, K. (2011). System oceny jakości maszyn rolniczych. *Rozpr. Nauk. UP Pozn.*, 418.
- Grądkowski, M., Rogoś, E., Siwiec, E., Urbański, A. (1999). Oksydacyjne starzenie oleju sprężarkowego. *Probl. Eksploat.*, 4, 75–90.
- Jóska, M., Kołodziejski, D. (2008). Wybrane problemy eksploatacyjne pojazdów i maszyn rolniczych w zakresie ich serwisowania. *J. Res. Appl. Agric. Eng.*, 53, 2, 5–7.
- Juściński, S., Piekarski, W. (2008). Analiza statystyczna obsługi serwisowej ciągników rolniczych w aspekcie odległości od siedziby firmy. *Inż. Roln.*, 100, 2, 57–65.
- Juściński, S., Piekarski, W. (2009). Rozkład zapotrzebowania na przeglądy serwisowe ciągników rolniczych w aspekcie terminów agrotechnicznych. *Inż. Roln.*, 117, 8, 31–38.
- Juściński, S., Szczepanik, M. (2008). Przeglądy gwarancyjne ciągników rolniczych jako element logistyki dystrybucji. *Eksploat. Niezawodn.*, 38, 2, 45–52.
- Osuch, A., Rybacki, P., Buchwald, T., Staszak, Ż., Ratajczak, J. (2015a). Analiza stanu wyposażenia gospodarstw rolnych w ciągniki rolnicze. *Problemy eksploatacji maszyn i ciągników rolniczych*. In: M. Lipiński, J. Przybył (eds.), *Aktualne problemy inżynierii biosystemów* (pp. 91–101). Poznań: Wyd. UP.
- Osuch, A., Rybacki, P., Kot, W. (2015b). Analiza stanu wyposażenia gospodarstw rolnych w kombajny do zbioru zbóż. *Tech. Roln. Ogrodn. Leśn.*, 3, 10–12.
- Rybacki, P. (2009). Nanotechnologia w obsłudze technicznej maszyn rolniczych. *Tech. Roln. Ogrodn. Leśn.*, 5, 11–13.
- Rybacki, P., Durczak, K. (2011). Ocena jakości serwisu technicznego maszyn rolniczych. *Inż. Roln.*, 134, 9, 201–206.
- Rybacki, P., Durczak, K. (2012). Hierarchizacja kryteriów oceny jakości procesów serwisowania maszyn rolniczych metodą porównywania. *Inż. Roln.*, 136, 2, 299–306.
- Rzeźnik, Cz. (2008). *Podstawy obsługi technicznej maszyn rolniczych*. Poznań: Wyd. AR.
- Skrobacki, A., Ekielski, A. (2006). *Pojazdy i ciągniki rolnicze*. Warszawa: Wieś Jutra.
- Tomczyk, W. (2009). Obsługi techniczne w procesie odnowy i utrzymania maszyn i urządzeń rolniczych. *Inż. Roln.*, 115, 6, 301–307.

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Streszczenie

Obsługa techniczna jest integralną częścią systemu eksploatacji ciągników i innych maszyn rolniczych. Procesy serwisowania obejmują głównie operacje wchodzące w skład planowanych okresowych przeglądów technicznych, których celem jest zapewnienie obiektom technicznym zdolności do użytkowania i maksymalnego wydłużenia okresu ich bezawaryjnej pracy. Celem badań było uzyskanie informacji dotyczącej sposobów wykonywania obsługi technicznej ciągników rolniczych eksploatowanych w rodzinnych gospodarstwach rolnych oraz określenie prawidłowego przestrzegania ich harmonogramu. Badania wykonano z wykorzystaniem kwestionariusza

ankietowego wśród rolników z województwa wielkopolskiego. Jak wynika z tych badań, większość rolników dokonuje obsługi technicznej ciągników we własnym zakresie, ignorując przy tym harmonogram wykonywania przeglądów technicznych określony w instrukcji obsługi pojazdu.

Słowa kluczowe: serwisowanie maszyn, ciągnik rolniczy

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