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The Impact of the Method of Reclamation of the Coal Ash Dump from the "Adamów" Power Plant on the Survival, Viability, and Wood Quality of the Introduced Tree Species

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Abstract: The aim of this research was to determine the survival rate, dimensions, and wood quality of black locust, ash-leaf maple, common maple, and American ash introduced to the landfill of the "Adamów" Power Plant as part of the reclamation process. The experimental area consisted of 13 research plots. On the three plots where the trees were planted directly into the ash, the trees completely collapsed. As a result of this research, it was found that the black locust had the best survival rates, whereas the American ash had the worst. The black locust and ash-leaf maple reached larger sizes on the plots where the ashes were covered with a 50-centimetre layer of sewage sludge (S50) or with a 50-centimetre layer of clay (C50), while the common maple grew the largest on the plots where a 25-centimetre layer of sewage sludge (S25) was used. Our research shows that about 40% of the examined species of wood were of good quality (Q1, Q2), which in the future will make it possible to obtain sawmill raw material. On the other hand, lower quality wood (Q3, Q4), which accounted for over 50% of the assessed wood material, can be successfully used as a biomass for energy purposes.

Keywords: black locust; ash-leaf maple; common maple; American ash; tree height; DBH; energy biomass

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1. Introduction

In Central and Eastern Europe, even now, coal remains the main source of electricity. Currently, coal mining is conducted in 41 regions of 12 Member States of the European Union. This provides employment for about 185 thousand people, as well as additional jobs in secondary industries [1]. In Poland, the share of hard coal and lignite use in the country's energy balance exceeds 80%, whereas lignite (brown coal) is the cheapest energy carrier [2]. As a result of burning these fossil fuels, waste is generated, the annual production of which—all over the world—amounts to 750 million tons [3], while in Poland itself it is as much as 13.7 million tons [4]. According to Antonkiewicz [4], approximately 280 million tons of ash is deposited in such landfills throughout Poland. Only in the Konin–Turek Coal Basin, the area of active landfills exceeds 800 ha. In most cases, the ashes are transported hydraulically to the landfills. As a result of varying intensity of processes such as leaching, hydrolysis, and hydration, the physical, chemical, and physicochemical properties of the coal ash may vary to a great extent. A strongly cemented ash rock is formed, dominated by compounds of silicon and calcium. Ahmaruzzaman [5], Ukwattage et al. [6], and Mocek-Płóciniak [7] reported that lignite ash might contain as much as 12 to 25% of calcium.

The adopted transport system as well as the quality of the coal itself and the combustion technology used all significantly impact the properties of ash [8]. Ash dumps are subject to obligatory reclamation [9].

Combustion waste dumps are characterized by unfavourable or even adverse properties for most of the introduced plant species, such as highly alkaline reaction, susceptibility to erosion and cementation, as well as nutrient deficiency (mainly the deficits of nitrogen and phosphorus) [7,8,10–15]. In turn, Haynes [12] and Técher et al. [16] found that the lack of nitrogen is the main factor limiting the potential growth of vegetation on the ash substrate. Due to the significant deficiency of nitrogen and phosphorus and the alkaline reaction in the reclamation of such nutrient-poor anthropogenic soil formations, N-fixating species are introduced: black locust (*Robiniapseudoacacia* L) [8] and alders (*Alnus* spp.) [17–19]. Due to their symbiosis with *Rhizobiaceae* bacteria, they increase the nitrogen content in the soil and produce nutrient-rich, rapidly decomposing organic material [20]. Reclamation treatments are also necessary to improve the habitat conditions for plants through mineral fertilization and covering or filling the holes with fertile material [13]. Gilewska [8] also points out that in the rehabilitation of ash dumps, in addition to the species that bind atmospheric nitrogen from the air, calciphilic species should also be introduced.

In such specific habitats, which are notoriously difficult to rehabilitate, vegetation grows in conditions of strong competition for water resources, as well as for macro- and microelements. Improper circulation of elements may cause distortions in the process of tree stand nutrition [21]. Such habitat conditions result in the formation of atypical stand structures, and above all, they affect the quality of wood of the introduced tree species compared to stands of the same species found in natural habitats [22–24]. However, lower quality wood from such facilities may be fully suitable as a source of biomass for energy purposes. In Poland, since 1954 [25], organized reclamation activities have been conducted, which only today make it possible to draw the accurate conclusions and realistically assess the correctness of the reclamation treatments. It is also today—that is, twenty, thirty, or forty years after the afforestation of post-industrial objects—that we can begin the process of verifying the survival rates and viability of the introduced tree species and the quality of the resulting timber in these different habitat conditions.

The aim of this study was to determine the survival rate, viability, dimensions, and the wood quality of tree species introduced into the landfill of the "Adamów" power plant as part of the reclamation process, depending on the reclamation treatments performed.

2. Material and Methods

The research facility was located near Konin, in the Wielkopolska Region (in the central-western part of Poland). The experimental site, which was situated at the coal combustion waste dump of the "Adamów" power plant, was located in the western part of the "Adamów" mine open pit (see Figure 1).

The experimental site was established by Bender and Gilewska in 1999, in the form of 13 research plots with the dimensions of 61 m × 16 m (see Table 1). The plots consisted of 6 rows each, at intervals of 2.5 m, and the spacing between the plots was 3 m. A total of 46 seedlings from 4 tree species were planted on each of the 13 plots: black locust (*Robiniapseudoacacia* L.), ash-leaf maple (*Acer negundo* L.), common maple (*Acer platanoides* L.), and American ash (*Fraxinus americana* L.). They were accompanied by 4 species of shrubs: oleaster (*Elaeagnus angustifolia* L.), caragana (*Caragana arborescens* Lam.), dogwood (*Cornussanguinea* L.), and sea buckthorn (*Hippophaerhamnoides* L.). In total, 368 trees and shrubs were planted on each plot in the alternating tree—shrub configuration with the spacing of 2.5 m × 1.0 m [26].

Research work was carried out in 2020 on 13 research plots (Nos. 1, 2, 3, 4, 5, 6, 7, 12, 13, 14, 15, 16, 17) established in 1999, where tree species introduced as part of reclamation treatments grew. On plots Nos. 1, 2, and 3 (ash), all trees introduced as part of reclamation treatments involving direct planting in the ash collapsed. After a dozen or so years, single specimens (1–2) of black locust appeared on the above-mentioned plots, which entered the study area by succession; therefore, these plots could not be tested. The 10 plots analysed were divided into three groups, according to the type of substrate with which the coal combustion waste was covered during the reclamation treatments:

S25—coal combustion waste was covered with a 25-centimetre layer of sewage sludge;
S50—coal combustion waste was covered with a 50-centimetre layer of sewage sludge;
C50—coal combustion waste was covered with a 50-centimetre layer of clay.

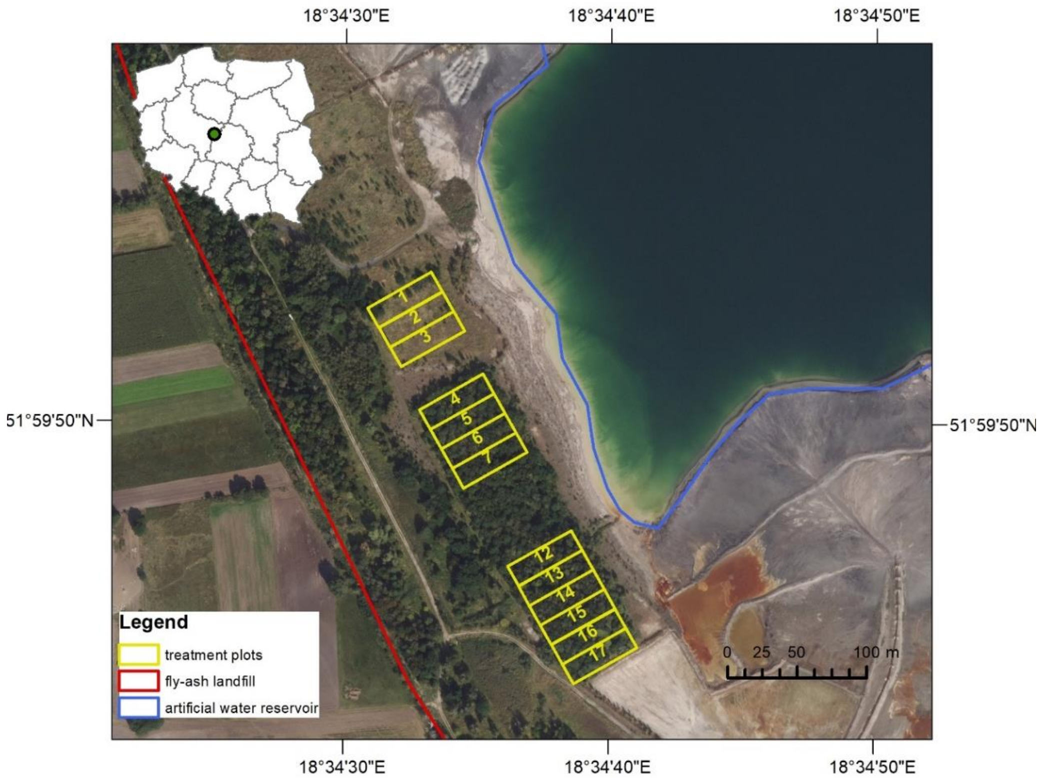

Figure 1. Location of the experimental site within the ash landfill on the background of orthophotomap (http://mapy.geoportal.gov.pl), accessed on 20 January 2023.

Table 1. Characteristics of the plots established within the experimental site.

Characteristics of the Plots		
Plot Number	**Layer Name**	**Cover Thickness**
1	ash	0
2	ash	0
3	ash	0
4	sewage sludge	25
5	sewage sludge	25
6	sewage sludge	25
7	sewage sludge	50
12	clay	50
13	clay	50
14	clay	50
15	clay	50
16	clay	50
17	sewage sludge	50

On each tree, the following measurements were performed: DBH (diameter at breast height) of each tree > 7 cm thick using a DBH gauge; height of each tree growing on the research plots using a Suunto altimeter; also, the quality of the raw material of each tree was determined, and the types of wood defects that influenced the classification result were recorded. Based on the Polish Standard for the classification of medium-sized wood [27], the following qualitative groups—designations were created:

Q1—trees of the best quality, good-looking, straight, with only few and slight curves or no curves whatsoever, well-cleaned, promising for the future, with prospects for good quality classes of large-sized timber (class A or B);

Q2—trees of medium quality, straight or with pronounced curves, moderately cleaned, promising for the future, with prospects for lower quality classes of large-sized timber (class C or D);

Q3—trees of poor quality, with clearly pronounced and numerous curves, poorly cleaned, thin, with poor prospects for the future timber;

Q4—trees of the worst quality, with obvious and numerous curves, abundantly and intensely branched, not cleaned, insect galleries can be seen on the cut, with no prospects for timber in the future.

On the basis of the measured DBH and height values, the volume of individual trees was determined using the volume tables of standing trees [28].

Statistical Analysis

Due to the fact that after applying the Shapiro–Wilk test, the null hypothesis of the normality of data distributions was rejected, the Kruskal–Wallis test and the post-hoc multiple comparison test were employed in order to analyse the statistical significance of the differences observed [29,30]. The significance level $\alpha = 0.05$ was adopted in the statistical analyses.

3. Results

Only four tree species that had been planted as part of the reclamation were measured: black locust (BL), ash-leaf maple (ALM), common maple (CM), and American ash (AS). In addition, American ash was found only on plots C50, while on plots S25 and S50, the species had almost completely collapsed. The quality and viability of the introduced shrubs were not studied, and neither was the effect of fertilization applied for four years after the trees and shrubs were planted on the experimental site.

Among the four species introduced into the coal ash dump as part of the rehabilitation effort, the black locust had the highest survival rate (see Figure 2). The tested species achieved the highest survival rate on the plots where the coal combustion waste was covered with a 50-centimetre layer of clay (C50), and a 25-centimetre layer of sludge sediment (S25). Ash-leaf maple and common maple showed poorer survival rates. The species with the poorest survival rate was the American ash, with an average survival rate of only 15%. This species was characterized by a very poor survival rate on the plots where, as part of the reclamation treatments, combustion ash sediments were covered with a 25-centimetre (S25) or 50-centimetre (S50) layer of sewage sludge (1.5% and 2.2%, respectively). Only in the formations covered with clay (C50), it showed almost a 30% rate of survival.

The trees growing on all the examined plots were characterized by a large variation in the minimum and maximum DBH values (see Table 2). Black locust had the highest mean DBH, whereas the highest values were found on the plots covered with the 50-centimetre-thick sewage sludge, and 50-centimetre-thick clay (S50 and C50) (see Figure 3, Table 2). That notwithstanding, the Kruskal–Wallis statistical test showed no statistically significant differences between the mean DBH measurements in the individual groups of plots ($H = 5.3978$, $p = 0.0608$). Ash-leaf maple and common maple were characterized by similar average DBH values. It can be observed, however, that the common maple showed greater thickness on the plots covered with the 25-centimetre- and 50-centimetre-thick sludge (S25 and S50), whereas the ash-leaf maple showed greater thickness on the plots covered with the 50-centimetre-thick sludge (S50). In the case of the ash-leaf maple, the statistical test showed no significant differences between the mean DBH values (H = 4.8011, $p = 0.0907$), while in the case of the common maple, significant differences were found between the trees growing on the formations covered with a 25-centimetre layer of sediment and clay (S25-C50, $p = 0.0016$), and between those covered with a 50-centimetre layer of sludge sediment and clay (S50-C50, $p = 0.0017$). No statistically significant differences were found on the plots covered with the sludge sediments (S25–S50). For the American ash, the comparisons were made only for the formations covered with clay (C50), because only single specimens of trees were left on other formations (S25 and S50—2 trees each). Compared to other species, the ash showed the smallest measurements of DBH.

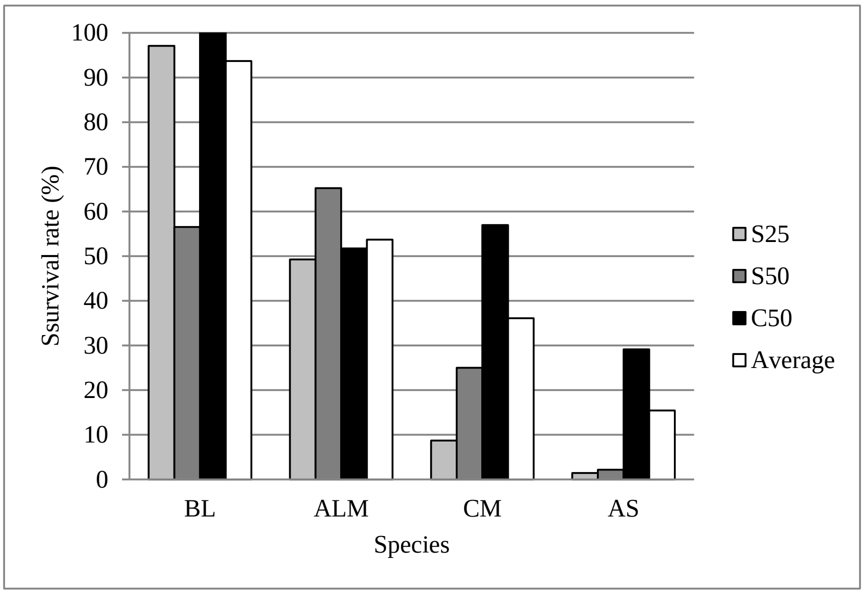

Figure 2. Survival rate of the studied tree species in individual groups of research plots. Notes: BL—black locust; ALM—ash-leaf maple; CM—common maple; AS—American ash; S25—combustion waste covered with sewage sludge, 25 cm thick; S50—combustion waste covered with sewage sludge, 50 cm thick; C50—clay-covered combustion waste.

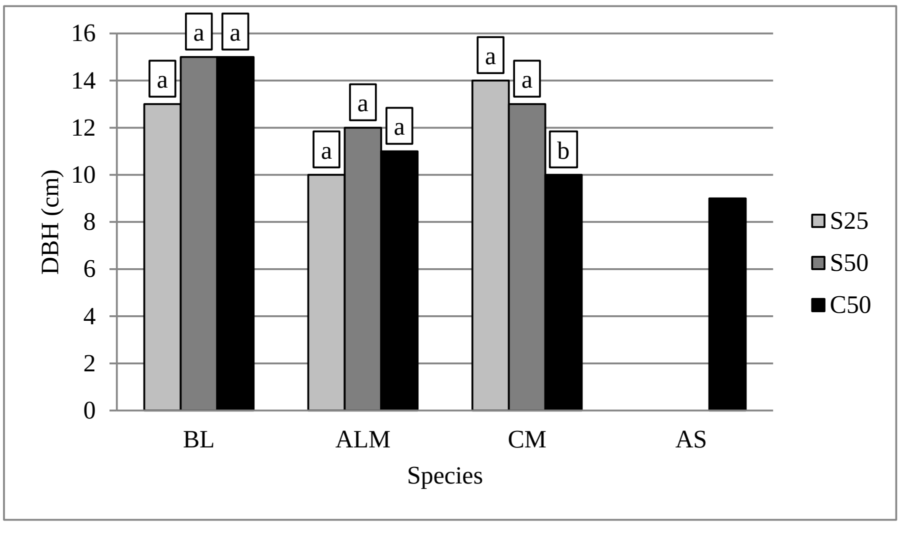

Figure 3. Median DBH of the studied tree species in individual groups of research plots. Notes: BL, ALM, CM, AS—explanations as in Figure 2, different letters indicate significant differences ($p \leq 0.05$) according to the K–W test between treatments within a species.

Table 2. Statistical characteristics of the studied tree species in individual groups of research plots.

Cover Name	Species	Features of Trees	Average	Min	Max	Standard Deviation	Coefficient of Variation
S25	BL	DBH (cm)	13.9	7.0	25.0	4.05	29.09
		H (m)	12.3	10.6	14.8	0.79	6.43
		V (m^3)	0.10	0.01	0.35	0.07	69.09
	ALM	DBH (cm)	11.0	7.0	22.0	3.48	31.56
		H (m)	11.6	10.3	14.0	0.76	6.56
		V (m^3)	0.06	0.01	0.25	0.05	84.60
	CM	DBH (cm)	14.4	11.0	20.0	2.90	20.12
		H (m)	12.3	11.3	13.5	0.61	4.99
		V (m^3)	0.10	0.04	0.21	0.05	50.82
S50	BL	DBH (cm)	15.2	7.0	25.0	3.79	24.93
		H (m)	13.7	11.5	16.7	1.07	7.79
		V (m^3)	0.12	0.01	0.40	0.07	58.21
	ALM	DBH (cm)	12.8	7.0	24.0	4.23	33.05
		H (m)	13.1	11.4	16.4	1.20	9.16
		V (m^3)	0.09	0.01	0.34	0.08	88.71
	CM	DBH (cm)	13.7	7.0	22.0	3.66	26.65
		H (m)	13.4	11.4	15.8	1.07	7.94
		V (m^3)	0.10	0.01	0.29	0.07	65.81
C50	BL	DBH (cm)	14.8	8.0	30.0	3.91	26.38
		H (m)	13.7	10.4	20.8	1.73	12.61
		V (m^3)	0.12	0.02	0.64	0.09	76.04
	ALM	DBH (cm)	11.6	7.0	26.0	3.81	32.97
		H (m)	12.4	9.3	19.3	1.76	14.12
		V (m^3)	0.08	0.01	0.80	0.10	132.26
	CM	DBH (cm)	11.0	7.0	21.0	3.04	27.60
		H (m)	12.0	9.1	15.5	1.27	10.54
		V (m^3)	0.06	0.01	0.24	0.05	80.42
	AS	DBH (cm)	9.7	7.0	23.0	3.1	31.98
		H (m)	11.7	9.3	18.4	1.5	12.71
		V (m^3)	0.04	0.01	0.36	0.06	131.00

Notes: BL—black locust; ALM—ash-leaf maple; CM—common maple; AS—American ash; S25—combustion waste covered with sewage sludge, 25 cm thick; S50—combustion waste covered with sewage sludge, 50 cm thick; C50—clay-covered combustion waste.

The average heights of the studied species in the researched groups of formations were similar, and they ranged between 12 and 14 m. Trees growing on all the plots under the study were generally characterized by a small variation in height, which is confirmed by low values of the coefficient of variation of the discussed feature. Having said that, similarly to DBH, a slight advantage in the height of black locusts over other species was noticeable (see Figure 4, Table 2). It was also found that the black locust and ash-leaf maple measured higher on the plots covered with S50 and C50, whereas the common maple grew higher on the plots covered with S25 and S50. In the black locust, significant differences were found between the height of the trees growing on the plots covered with

25-centimetre-thick sewage sludge and the plots covered with 50-centimetrethick sewage sludge and clay (S25–S50, $p = 0.0000$ and S25–C50, $p = 0.0000$). However, no statistically significant differences were found between the height of the trees growing on the plots covered with 50-centimetre-thick sewage sludge and with clay (S50–C50). In the case of the ash-leaf maple, all data groups differed significantly (S25–S50, $p = 0.0000$; S25-C50, $p = 0.0001$ and S50–C50, $p = 0.0019$). In turn, in the case of the common maple, significant differences were found between the trees growing on the formations covered with sludge sediment (S25–S50, $p = 0.0036$) and between the formations covered with a 50-centimetre layer of sludge sediment or clay (S50–C50, $p = 0.0000$). No significant differences were found between the trees growing on the formations covered with a 25-centimetre layer of sludge sediment or clay (S25–C50).

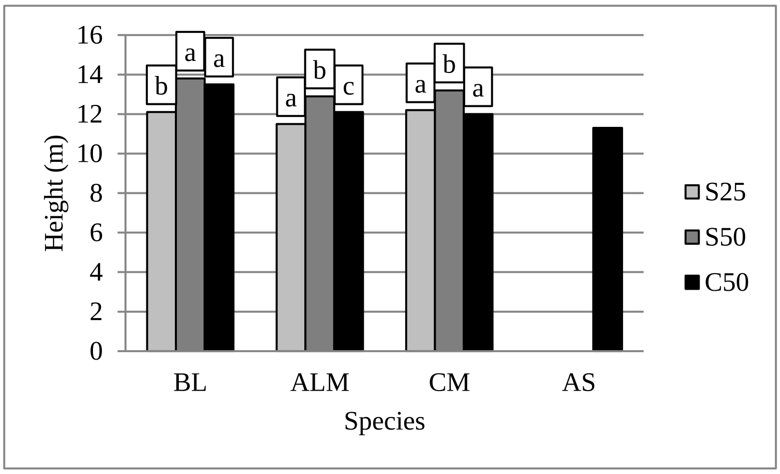

Figure 4. Median heights of the studied tree species in individual groups of research plots. Notes: BL, ALM, CM, AS—explanations as in Figure 2, different letters indicate significant differences ($p \leq 0.05$) according to the K–W test between treatments within a species.

The most diversified of the examined growth parameters was the volume of trees growing on the examined plots. The high variability of this feature is indicated by the high value of the coefficient of variation (always greater than 50%) for the feature in question, on all plots examined. The black locust demonstrated the highest mean volumes, and the highest volumes were found on the plots covered with S50 and C50 (see Figure 5, Table 2). These differences were also confirmed by a statistical test, which showed statistically significant variation between the volume of trees growing on the plots covered with 25-centimetre-thick sewage sludge, and plots covered with 50-centimetrethick sewage sludge and clay (S25–S50, $p = 0.0143$ and S25–C50, $p = 0.0035$). However, no statistically significant differences were found between the volumes of trees growing on the plots covered with 50-centimetre-thick sewage sludge and those covered with clay (S50–C50). In the case of the maples, it can be observed that the common maple showed greater volumes on the plots covered with sludge sediment (S25 and S50), and the ash-leaf maple on the plots covered with S50. Despite this, in the case of the ash-leaf maple, the statistical test did not show statistically significant differences between the mean volumes (H = 5.1901, $p = 0.0746$), whereas in the case of the common maple, statistically significant differences were found between the trees growing on the formations covered with a 25-centimetre layer of sludge sediment and clay (S25–C50, $p = 0.0059$) and between the formations covered with a 50-centimetre layer of sediment and clay (S50–C50, $p = 0.0013$). No statistically significant differences were found in the formations covered with sludge sediments (S25–S50). For the American ash, the assessments were made only for the formations covered with clay (C50) to conclude that compared to other species, the American ash showed the lowest volumes.

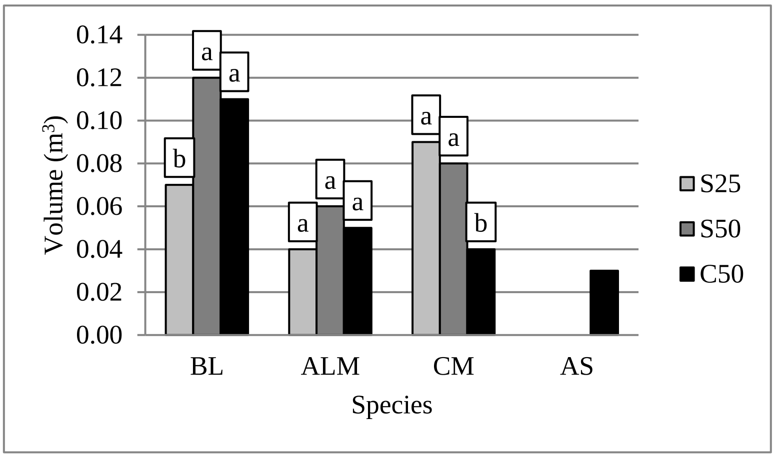

Figure 5. Median volume of the studied tree species in individual groups of research plots. Notes: BL, ALM, CM, AS—explanations as in Figure 2, different letters indicate significant differences ($p \leq 0.05$) according to the K–W test between treatments within a species.

When analysing the quality of wood of individual species, we cannot fail to notice that in the case of the black locust, the quality of wood (the sum of the shares of the Q1 and Q2 groups) decreases with the increase in fertility of the soil formations (see Figure 6). In the case of the maple, the opposite correlation was observed—along with the increase in the fertility of the soil formations, the quality of the timber also increases. The ash growing on the clay-covered plots (C50) showed poor timber quality. It was found to have an advantage of the inferior qualitative groups (Q3 and Q4) over the good quality groups (Q1 and Q2).

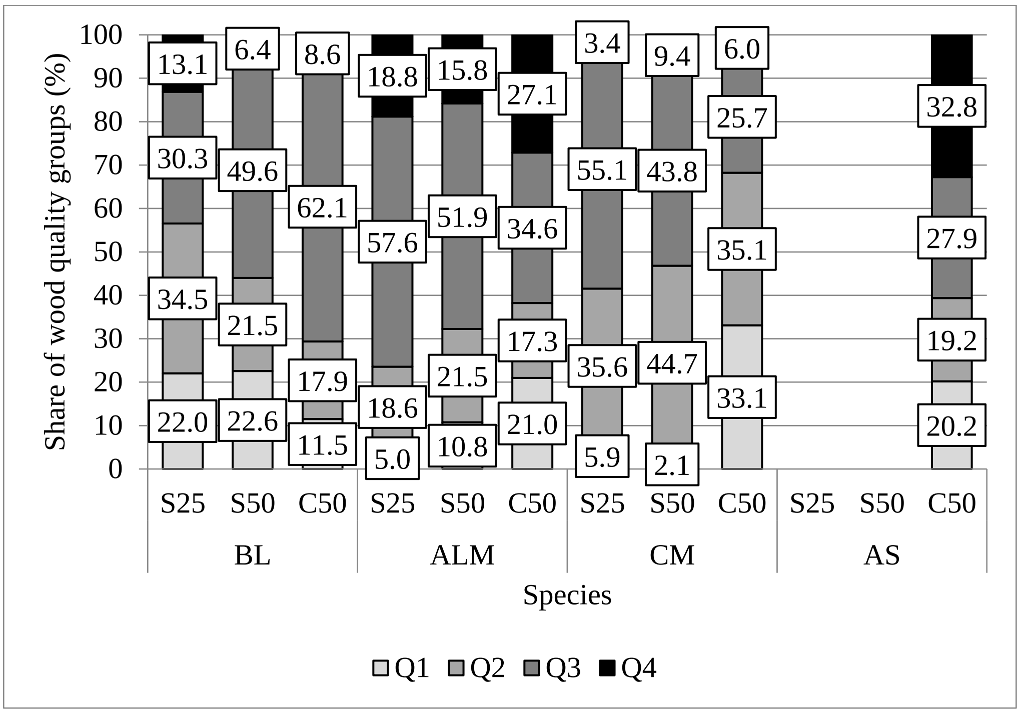

Figure 6. Share of wood quality groups of the studied tree species in individual groups of research plots. Notes: BL—black locust; ALM—ash-leaf maple; CM—common maple; AS—American ash; S25—combustion waste covered with sewage sludge, 25 cm thick; S50—combustion waste covered with sewage sludge, 50 cm thick; C50—clay-covered combustion waste; Q1, Q2, Q3, Q4—wood quality groups.

Taking into account the share of wood defects influencing the results of timber quality classification, it can be concluded that in all species it was the curvature (either one-sided or multilateral) that had the overriding influence on the result of wood classification (see Figure 7). At the same time, along with the increase in thickness of the deposits, the share of multilateral curvatures increased. Occasionally, there were also insect galleries present; also on occasion, specimens of trees were found with no wood defects that would significantly affect the quality of the raw material.

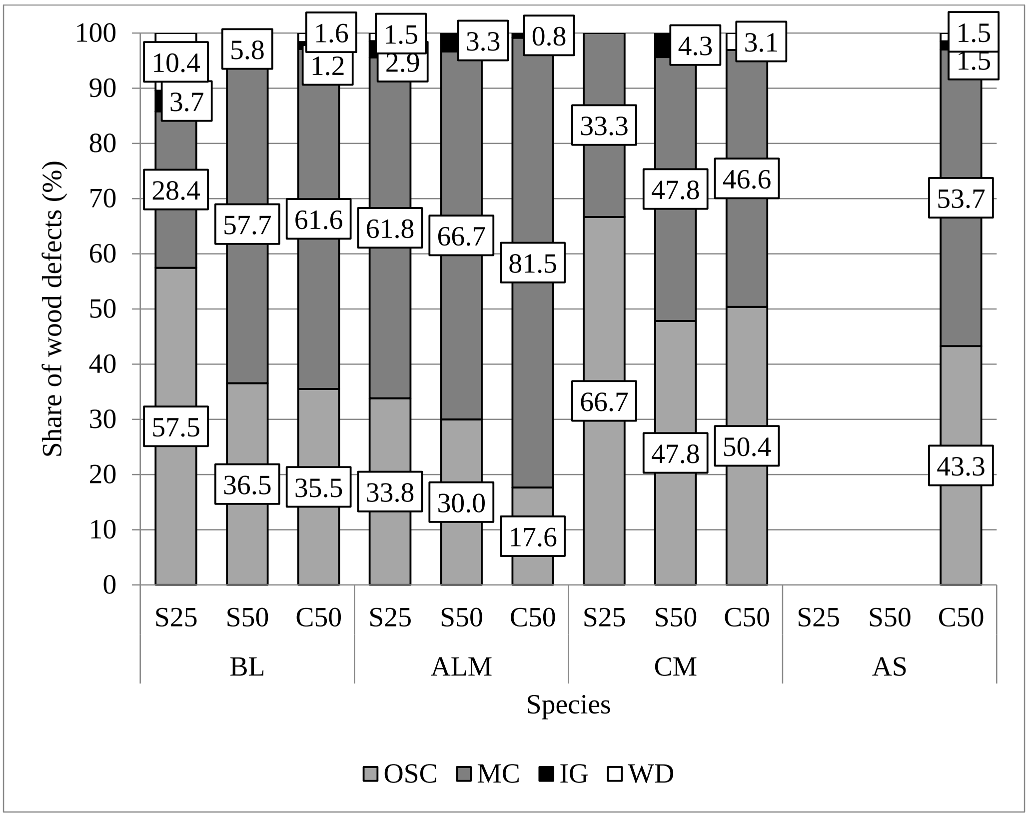

Figure 7. Share of wood defects influencing the result of timber quality classification in the studied tree species in the individual groups of research plots. Notes: BL—black locust; ALM—ash-leaf maple; CM—common maple; AS—American ash; S25—combustion waste covered with sewage sludge, 25 cm thick; S50—combustion waste covered with sewage sludge, 50 cm thick; C50—clay-covered combustion waste; OSC—one-sided curvature; MC—multilateral curvature; IG—insect galleries; WD—without defects.

4. Discussion

Due to the highly alkaline reaction, susceptibility to erosion, cementation, as well as the deficiency of nutrients, ashes generated during the combustion of lignite make very difficult substrates for biological reclamation [10,11,13–15]. Tree-planting reclamation conducted in the coal ash dump of the "Adamów" power plant, thanks to various reclamation treatments at the stage of establishing the experimental plot, currently provides us with a wealth of new information about the survival rates, growth rates, and wood quality of the introduced tree species. The conducted research confirms that the survival rate, growth, and wood quality of trees of the species introduced as part of the reclamation effort in the landfill of the "Adamów" power plant largely depend on the specific reclamation treatments performed. Over a period of 22 years (1999–2020), all trees of four species (black locust, ash-leaf maple, common maple, and American ash) introduced into the coal ash landfill completely collapsed on the plots where they were planted directly into the ash. This indicates the unfavourable properties of ash for the growth and development of these tree species. The reclamation treatment consisting in covering the coal combustion waste stored in the settling tank with a 50-centimetre layer of sewage sludge (S50) or a 50-centimetre layer of clay (C50) turned out to be the best solution, because the tree species introduced on such substrates had the best quality parameters and most advantageous dimensions. It has also been demonstrated that the most suitable species for such areas is the black locust and to a lesser extent the ash-leaf maple and the common maple. In turn, the American ash should not be introduced to such formations, because its survival rate in this setting is low.

Black locust can grow rapidly even in infertile soils that are too poor for other annual plants or woody plants [31,32]. It is also known for its tolerance to drought and for its low demand for nitrogen; therefore, it is often planted in marginal sites such as post-mining areas [32]. However, despite its low nutritional requirements and field conditions, insufficient phosphorus can reduce its N2-binding capacity, which can lead to reduced biomass production [33]. At the same time, Kanzler et al. [34] demonstrated that a relatively moderate amount of phosphorus (60 kg/ha^{-1}) had a strong influence on the growth of the studied trees. The black locust is expected to become an economically important, multifunctional species in many parts of Europe: as a nitrogen-fixing species, suitable for the rehabilitation of wastelands and open-cast mines in order to prevent erosion; for carbon dioxide sequestration as windbreaks and re-forestation species; as ornamental tree in parks and gardens; as a tree suitable for city streets as it tolerates air pollution and salinity well, and it thrives in the urban environment [35]. Black locust is one of the most promising species of trees used to establish plantations of fast-growing trees [32]. The high energy parameters of black locust wood [36,37] emphasize the possibility of its use as an excellent biomass for energy purposes.

The findings of many studies [34,35] indicate that, depending on the country (within the European continent), the black locust grows the fastest until the age of 10, that after 15 years its growth slows down, and that at the age of about 20 it reaches a height of about 20 m. Similarly, with the increment in diameter, the black locust reaches a thickness of about 20 cm for this parameter. In the present study, the black locust showed smaller heights and smaller diameters (about 14 m high and about 15 cm in diameter), which may be due to the challenging conditions in which it grew. Similar results were obtained in the reclaimed post-mining areas of opencast lignite mine in north-western Greece [38]. The inventory showed that the growth traits of the trees were very diverse due to the differences in their age (approx. 5–35 years). The DBH and height across the entire study area ranged from 1.4 to 22.3 cm and 2.5 to 17.2 m, respectively. These authors emphasize that the black locust has adapted well to these difficult conditions, and that it can be successfully introduced in such areas. However, when doing so, its invasive nature should be taken into account. Kraszkiewicz [39] states that the content of nutrients in the soil plays a minor role because the black locust grows very well in poorly fertile soils, often subjected to erosion processes. That notwithstanding, the author also notes that trees growing in the sandy areas of the outer dump of the Piaseczno sulphur mine demonstrate lower heights (from 15.5 to 18 m) and lower DBH (from 16 to 23.5 cm) than trees growing on clay formations (height from 18 to 24.5 m, and DBH from 18 to 26.5 cm). He notices, however, that the black locust growing in sandy areas is doing better on moist, shaded slopes with northern exposure. In such areas, the volume of the tree stands was observed to be the highest, 353.8 m^3/ha^{-1}, which is 60% higher than the average volume of the remaining 35-year-old stands.

Taking into account the quality of the raw material, it was found that the black locust produces the best quality wood on weaker soil formations (with a greater share of wood in the timber quality groups Q1 and Q2), and the more fertile the formations are, the worse the quality of the timber it produces. By contrast, the opposite tendencies were observed in the case of the maples—the quality of their timber increased with the fertility of the soil formations, which was related to a greater thickness of the applied deposits.

Research on pine trees introduced into reclaimed areas [22,40–42] showed opposite trends to those obtained in the present study. The above listed authors showed that pine trees grow better on poorer (sandy) or less fertilized formations. They explain this by the fact that the pine is better adapted to sandy soils, which resemble the natural conditions of its vegetation. Some authors even argue that the pines introduced into post-mining lands grow better than in forest areas [42–44]. This is mainly due to a higher content of K and Ca in the soil, which significantly affects the growth of trees in post-mining areas. Similar correlations were also observed for certain deciduous species, for instance, poplars [23,45]. Moreover, the research by Węgorek [46] on the growth of aspen introduced into the sulphur mine dump in Piaseczno showed that aspen introduced into sandy areas yielded very good growth increments, while on clayey formations, these increments were much smaller.

5. Conclusions

Out of the four tree species introduced to the coal ash dump in 1999, we can observe that their direct introduction to the ash substrate was unsuccessful. The black locust demonstrated the best survival rate on the plots covered with sludge sediment or clay after 20 years of growth, and the American ash had the worst rates, which indicates that this species is not suitable for reclamation of this type of facilities, while the black locust is a species that can be used successfully and performs well in these difficult conditions. A greater thickness of the substrate—a 50-centimetre layer of sewage sludge (S50) or a 50-centimetre layer of clay (C50) covering the deposited coal ashes—contributed to most of the introduced tree species achieving higher DBH, height, and volume values. A greater thickness of the substrate—i.e., a 50-centimetre layer of sewage sludge (S50) or a 50-centimetre layer of clay (C50)—covering the stored ashes also had a positive impact on the quality of the wood raw material in the case of the maple, while in the case of the black locust, the quality of the wood material was higher on the plots where a thinner layer of sediment (S25) was applied. Moreover, it was found that the result of the classification of the quality of the wood raw material in all tested species was decisively influenced by curvature, whereas on the plots where a 50-centimetre layer of sewage sludge (S50) or clay (C50) was applied, the proportion of multilateral curvatures increased. Our research shows that the production of good-quality black locust wood in such facilities requires the use of only 25 cm of a sewage sludge layer instead of 50 cm, the increase in its thickness increases the production of wood, but also causes an increase in the number of wood defects that reduce its quality. Our research shows that about 40% of the examined species of wood were of good quality (Q1, Q2), which in the future will make it possible to obtain sawmill raw material. On the other hand, lower quality wood (Q3, Q4), which accounted for over 50% of the assessed wood material, can be successfully used as a biomass for energy purposes.

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