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TECHNOLOGY, COMMUNICATION AND TRANSPORT

DEPRECIATION OF WELDING EQUIPMENT IN SHIPBUILDING INDUSTRY

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THESIS
Abstract

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Abstract

The aim of the thesis was to help to understand how the lifespan of the equipment and the consumables related to it can be increased in the field of shipbuilding industry. The thesis was commissioned by the shipbuilding company IMT-Metatech Oy.

In this thesis project theory of welding equipment, its lifespan, ways of maintaining the equipment, as well as depreciation theory were covered and implemented to a real company with welding equipment.

In this thesis project the possible solutions for the lifespan prolongation were presented, including the visualized depreciation of the equipment. This has built foundation for the possible changes in the current state of the welding equipment management in the IMT-Metatech Oy.

Keywords
Welding equipment, Welding machine, Welding helmet, Welding consumables, Lifespan of welding equipment, Depreciation, Straight line depreciation method, Declining balance method, Unit of production method, PP&E.

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1 INTRODUCTION

The shipbuilding industry is one of the most important and well-established sectors in the country. Finnish shipyards are producing various types of vessels, such as cruise ships, small multipurpose vessels, passenger ships, icebreakers, superyachts, car ferries and naval ships. Also, there are repair shipyards that are keeping the existing vessels in a proper condition. Commercial shipbuilding is a significant industry, where (Meyer Turku, 8) Meyer Turku Oy's share of the world's cruise shipbuilding market was approximately 12%.

Welding is a key process in ship construction, which is used almost during all the stages of the ship production. Welding is used to join (merge) metal pieces together, in modern shipbuilding, it is essential for hull construction as well as for internal and external features of the ship. In shipbuilding industry, it is inevitable that welding equipment is going to wear out over time. As they are used their value is going to decrease and it is known as depreciation. It is important to consider the condition of welding equipment in order to correctly manage project budgets and to make equipment replacement decisions. As older welding equipment becomes disused and the rate of depreciation increases, modern and advanced welding tools will be necessary for the successful continuation of shipbuilding operations.

1.1 Background of shipbuilding industry in Finland

The shipbuilding industry holds a significant role in Finland's economy, which involves 1100 companies, 25000 employees. The annual turnover of shipbuilding segment is 7.7 billion € and with the export share being over 90%, those statistics were taken for the year 2020 (Meriteollisuus 2023). The industry is based upon long-standing traditions and expert engineering skills, with the majority of produced vessels being highly sophisticated, specialized ships designed for worldwide operations. Europe's leading ferry producer and the leading provider of cruise vessels are both based in Finland. Moreover, in some specific kinds of ships, such as icebreakers or polar research ships, Finnish shipyards have almost a monopoly in building these types of ships globally. This strong market position can be attributed to a combination of many different competitive factors of the industry.

The shipbuilding industry in Finland has seen a significant amount of change and development in recent years. Modern technologies have been introduced and production has increased. These changes have had profound impacts on the equipment used in the shipbuilding industry, particularly in welding. As such, this equipment has become increasingly important. Well-maintained and modern welding tools are essential to meet the demands of the modern shipbuilding industry.

1.2 Importance of welding equipment in shipbuilding

Welding is a common process used for joining metal components in ships. It plays a significant role in the production processes and the quality of the ships. Proper welding techniques, high-quality of welding materials, and equipment are needed to ensure the proper condition of a weld in ship production. Welding technology has been continuously updated to meet the requirements of shipbuilding and to keep the quality and efficiency on a high level. For example, in the past, manual metal arc welding was the most popular technique in the shipbuilding industry. However, with different

ship structures and designs being developed over the years, semi-automatic welding and CO2 shielded welding have become the mainstream welding techniques in the industry and are widely used due to their high quality and efficiency.

Nowadays, robotic welding is increasingly used in the shipbuilding industry, which has further improved the quality of the welding and the productivity of the production processes. What is important to note here is that the welding technology and the method used shall be verified and qualified by the classification societies such as Lloyd's Register, DNV or the American Bureau of Shipping for the safety standards and regulations in the production of ships. Due to the high requirement of the welding quality in shipbuilding, all the welding staff in Finland are demanded to have a Welding certificate which should be approved by one of the trusted companies that do welders qualifications.

1.3 Significance of understanding depreciation in the industry

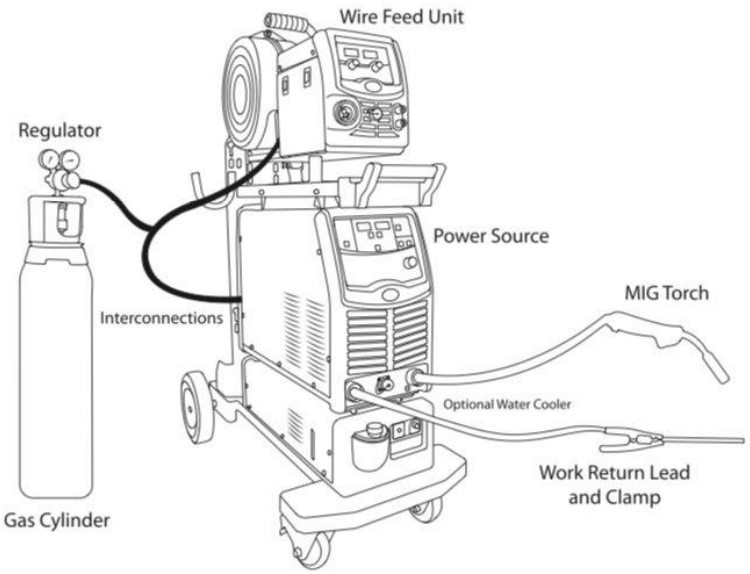
The shipbuilding industry is a crucial part of the economy in Finland, which is offering a wide range of jobs and opportunities. Many construction companies face continued pressure to win contracts and secure work, forcing companies to invest in up-to-date technology and equipment. However, the industry is famous for tight margins and highly competitive tender processes. As a result, companies must make the most of their assets and ensure that equipment is as reliable and cost-effective as possible.

Understanding depreciation is important because it helps companies to manage their assets more effectively and streamline business processes. For example, if companies know how value in an asset will decrease over time, they can plan and make sure that replacement equipment is available when needed. Similarly, calculating and applying depreciation can provide organizations with financial data that can be used to develop strategies and make proper business decisions. It is essential to understand not only what depreciation is and how it is calculated, but also how it can affect on the industry.

2 WELDING EQUIPMENT

2.1 Welding machine

Welding machine is a complex, multipart equipment, which most used types of welding machines in hull assembly are MIG/MAG welding machines. They usually consist of power source, wire feed unit, welding torch (MIG torch), interconnecting cables, work return lead and clamp. One of the significant options of the welding machine is it to be able be transported easily as they whey about 25 kg without any other equipment attached to them.



PICTURE 1. Welding machine illustration (Jasic s.a.)

2.1.1 Power source

The power source converts the mains supply to a usable welding supply and its output is direct current (DC). In a standard MIG welder power source the relationship between voltage and welding current is termed as constant voltage characteristic. In the MIG/MAG process, welding current is determined by wire feed speed and arc length is determined by power source voltage level (open circuit voltage). (Jasic s.a.).

Wire burn-off rate is automatically adjusted for any slight variation in the distance between the gun and work piece, wire feed speed or current pick-up in the contact tip. The electrode MIG Gun is usually +VE and the work return is usually –VE. However, it can be completely opposite as certain consumable wires sometimes require what is called reverse polarity, where electrode is –VE and work piece is +VE). Typical of these types of wire are cored wires used in hard facing or high deposition and gasless applications. (Jasic s.a.).

2.1.2 Wire feed unit

In the wire feed unit a drive motor and feed roll system are used to feed the MIG wire. It can be built into the power unit to make it more compact, or it can come as a separate unit. Wire feed units can be either two or four roll drive. The way the wire feed system performs directly affects the

stability and producibility of MIG welding. Roll pressure must properly maintained, otherwise the wire can deform, and this affect the poor current pick up in the contact tip. (Jasic s.a.).

PICTURE 3. 4 Roll Drive (Jasic s.a.)

2.1.3 Welding torch (MIG torch)

The welding gun is one of the most crucial components of the system. It is not only directing the wire, but it also transfers the current to the wire (via contact tip) and the nozzle directs the shield gas around the arc and the weld pool. (Jasic s.a.).

PICTURE4. Welding torch (Mikhaylov, 2024)

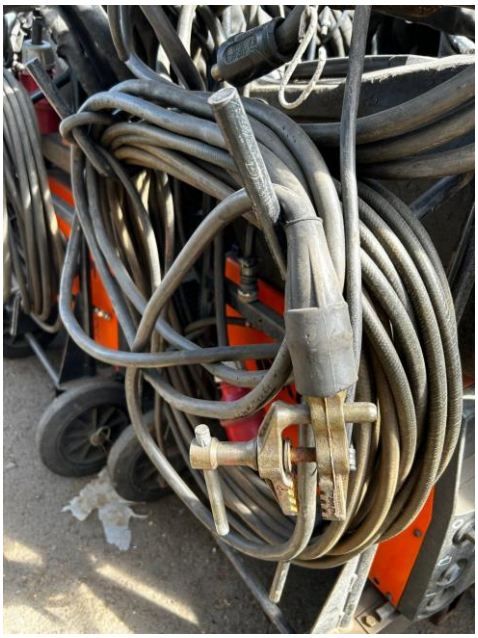
2.1.4 Interconnecting cables

System with a separate wire drive unit is connected to the power source by an interconnecting cable. Cables can vary by the cooling way either air or water and by length. The interconnections carry welding power, shield gas and control supply for the wire feed drive. (Jasic s.a.).

PICTURE 5. Interconnecting cables (Jasic s.a.).

2.1.5 Earth return cable

Earth return cable is also known as a "ground/neutral". It is mandatory to use it as electricity follows the path of the least resistance. The correct diameter of copper cable should be used for the amps being carried. The earth cable is connected to the welder with a cable plug and the clamp needs to be attached to the material being welded. (Jasic s.a.).



PICTURE 6. Earth return cable (Mikhaylov, 2024)

2.2 Welding helmet

Welding helmet is one of the important pieces of equipment for the welder. The main purpose of this tool is to protect the eyes of the person. There are various models of the welding helmets, but they can be divided into to 3 types according to their purpose:

- Euromask
- Welding mask
- Soft welding mask
- Welding helmet (with respiratory system).

2.2.1 Euromask

This welding mask is commonly used by the plate-fitters who don't to look at the bright light that comes from welding process. It perfectly fits for small duties that the plater should be able to manage and it is used in places with good ventilation.

It has two plastic visors that have different shading level. The larger one that protects the face of the person usually has the shading level of 3. And the one that is used to protect eyes during welding has the shading level of 8.

Picture 7. Welding mask Euromask (Wurth s.a.)

2.2.2 Welding mask

Welding mask is used by welders and has stronger eyes protection for welders. It has two layers of protecting classes: the transparent and shaded. Shaded glass is usually has shading level ranged from 9-12 and transparent glass is used to protect the shaded glass.

This mask is used for common duties of the welder. It is used for common tasks in well-ventilated areas with enough room for the head movement.

PICTURE 8. Welding mask (Mikhaylov 2024)

2.2.3 Soft welding mask

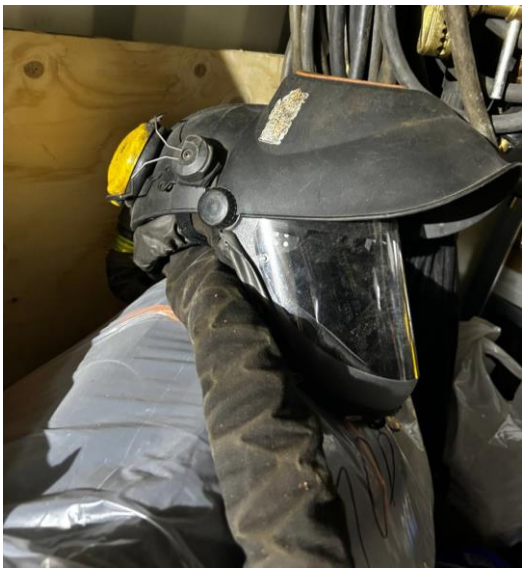
Soft welding mask is normally used by welders when they are working in the tight spots on the ship where there is too little room for the head. It has the same structure as the normal welding mask and has the same structure unlike it is made of the soft material for more comfortable usage.

PICTURE 9. Soft welding mask (Mikhaylov 2024)

2.2.4 Welding helmet with respiratory system

This type of helmet is used in closed areas with low air flow and poor air quality. It is airtight helmet with two protecting visors which are transparent and tinted. It has a separate block responsible for respiratory system.

The respiratory system can be present in 2 types, which are electrically powered respiratory system and the other one is operating with hose with air being plug into the system.



PICTURE 10. Welding helmet with respiratory system (Mikhaylov, 2024)

2.3 Welding consumables

Welding consumables are the crucial elements of the welding equipment, as these parts are loosing their quality and efficiency in a short period of time and they have to be changed if not on a daily basis but 2-3 times a week.

Here is the list of the most common consumables that are used in the welding equipment:

- Nozzle / Shroud
- Contact tip
- Contact adaptor
- Shaded / Transparent glass
- Fireproof gloves.

2.3.1 Nozzle / Shroud

Nozzle / Shroud can be threaded or non-threaded and can come in various shapes and sizes. They are usually made of copper. They are simple to clean and change and give better reachability for special applications such as root passes and narrow gaps. (Kemppi s.a.)

2.3.2 Contact tip

Contact tips provide proper welding current flow to the fillet wire. Most common sizes of contact tips ranges from 0.6mm to 1.6mm. Contact tips can come with 3.2mm size in some cases. (Kemppi s.a.)

PICTURE 11. Contact tips (Mikhaylov, 2024)

2.3.3 Contact adaptor

Contact adaptors are used as a mount for the contact tip. They are usually made out of copper or brass (Kemppi s.a.). They are rarely changed unless the contact tip had been damaged badly and cause damage on the contact adaptor.

PICTURE 12. Contact tip adapters (Kemppi s.a.)

2.3.4 Shaded / transparent glass

The most optimal shade for MIG welding is a shade, which ranges from 10-13 (Tulsa Welding School 2021). However, my company uses the range from 9-12. They can be changed couple times a week according to the production rate. Same situation with the transparent glass.

PICTURE 13. Shaded glass (Mikhaylov, 2024)

2.3.5 Fireproof gloves

An important piece of equipment for the welder as it protects his hands from the high heat, that comes from welding. Made out cow leather. Should be sewed with strong, heat resistant Kevlar thread. It is a significant addition to the welding equipment, as without fireproof gloves, welding is not allowed due to safety reasons. (Granberg s.a).

Depending on the work conditions they can be usually changed once a week.

PICTURE 14. Fireproof gloves (Mikhaylov, 2024)

2.4 Lifespan of welding equipment

Welding equipment has limited life, and it is important to keep it in the proper shape. The lifespan can depend on many factors such as environmental conditions, frequency of use and the skills of the person who is using the machine. The way the equipment is maintained and operated can either increase the life of the machine or decrease it. Here are the main tips for maintaining the equipment to benefit the durability over time:

- Keeping the machines covered, when not used. As construction sites are full of dust and other debris flying in the air. All the small particles can build up on various parts of the welding machine and cause troubles with it. (American torch tip s.a.).
- Turning off the gas and purging the system. By turning of the gas and purging the shielding gas from the machine and MIG torch, will benefit the systems components in a long run. (American torch tip s.a.).
- Hanging the MIG torch would at the end of the workday, can prevent the MIG torch from the damage(American torch tip s.a.).
- Inspecting the machine before the beginning of work. It is a good practice to identify and prevent of the problems in advance. (American torch tip s.a.).
- Keeping the machine clean. Even if the machine is stored properly, it can absorb a lot of debris while it is operating, especially on the site. That is why it is important to clean the machine from time to time. (American torch tip s.a.).
- Cleaning or replacing consumables. By doing this simple operation in time it can prevent the fatal failure from happening and breaking the whole machine down. (American torch tip s.a.)
- Calibrating the machines in time. This action is done to ensure, that the machine is operating properly according to standards. Without calibration the machine is not allowed to be operated. (ProWeld, 2023).

3 DEPRECIATION THEORY

3.1 Main definitions

Depreciation is the key way of measuring, how the asset is wearing out or loses in its value with the passage of time and use. This process allows to reduce a portion of assets value during each year of accounting period for the whole duration of the useful life of the asset. (CFI s.a.)

Depreciable asset are assets which have useful life of more than 1 year, generates profit or income and the value gets lower with the passage of time. (Legal Information Institute, 2021).

Useful life can be defined either as the asset's expected number of years, which it will be used or the by the amount of products or units it can produce while being able to generate revenue. (Investopedia, 2020).

3.2 Depreciation methods

There are multiple ways of calculating depreciation of the asset. Each of them helps to show the exact value of the depreciated asset during its useful life.

There are three main methods can be used to calculate the depreciation:

- The straight-line method
- The declining-balance method
- The unit-of-production method (CFI s.a).

3.2.1 The straight-line method

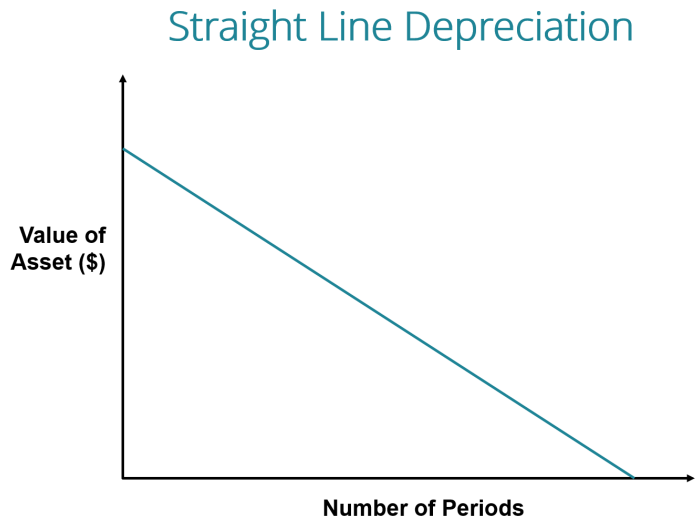
Straight line depreciation is the method used to identify the cost of the asset and can be the easiest to be implemented by the companies. It has simple formulas to use for depreciation calculations. (CFI s.a)

With straight line method, company are able to depreciate in several ways, such as with fixed annual percentage and fixed annual amount. In order to use the straight line depreciation method, some of the following parameters should be marked in the fixed asset depreciation book:

- The depreciation period (years or months) or a depreciation ending date
- A fixed yearly percentage
- A fixed yearly amount
- Depreciation period (Microsoft Learn, 2024).

$$Depreciation\ deduction = \frac{Investment\ cost - Salvage\ value}{Estimated\ Useful\ Life\ of\ Asset}$$

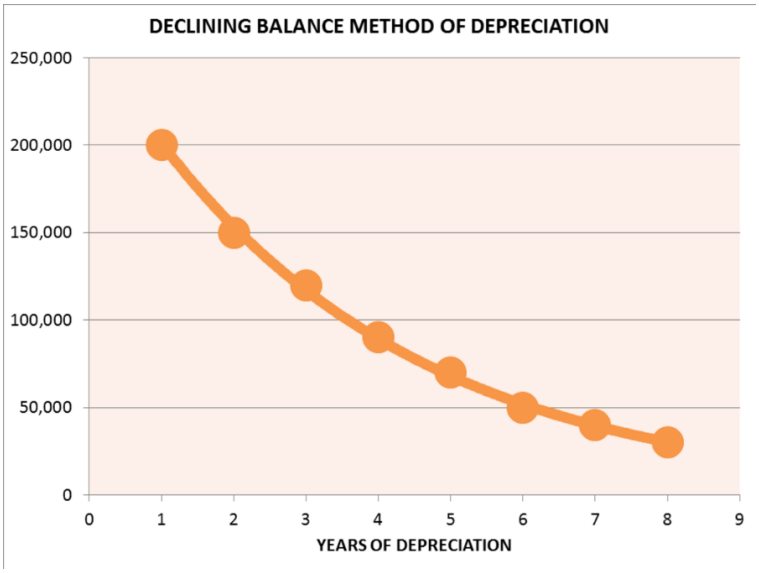
$$Depreciation\ rate = \frac{Depreciation\ deduction}{Investment\ cost - Salvage\ value}$$



PICTURE 15. Straight line depreciation (CFI Straight line depreciation s.a.)

3.2.2 Declining balance depreciation method or double-declining depreciation method

The declining balance method is a type of accelerated depreciation used to reduce depreciation costs during the first years of the useful life of the asset and to minimize tax exposure. With this method, fixed assets depreciate earlier in life compared to even value reductions as it is done in Straight line depreciation. This method can be used for the assets which loose more of their value or provide higher utility during the first years of useful life. Some companies are using double-declining balance method for more aggressive depreciation management strategies. (Investopedia, 2023).



PICTURE 16. Declining balance depreciation (Deskera s.a.)

$$Declining\ balance\ depreciation = CBV \times DR$$

- CBV – Current book value
- DR – Depreciation rate

If the company receives large gains when selling their assets, it can be a good indication that it is using accelerated depreciation methods. Net income can stay low, however the book value of the asset will turn out to be lower than the market value. Which leads to higher gains when the asset is sold and a misleading image of the company. (Investopedia 2022)

3.2.3 The unit-of-production method

Unit of production depreciation method is beneficial for the equipment, which useful life is better represented by the amount of units it produces during its lifespan rather than amount of years it will used. As a result, assets are getting depreciated at a higher pace if it had been used more frequently, and it would be depreciated less if the asset had been used less. This method allows companies to make deductions based on the used percentage amount of asset's production capacity. It leads to higher depreciation deductions if the equipment had been more productive. Unit of production method helps to accurately measure how worn off the asset is, based on its production numbers. As a result, it can be depreciated at a higher rate if the equipment was highly demanded compared to the Straight line depreciation method or accelerated depreciation methods (declining balance method and double-declining balance method). (Investopedia 2020)

$$DE = \frac{(Original\ Value - Salvage\ value)}{Estimated\ prduction\ capacity} \times U$$

- DE – Depreciation expense
- U – Units pre year

3.3 Property, Plant and Equipment (PP&E)

Property, Plant, and Equipment (PP&E) are fixed assets which are used by the companies to generate profit and revenue. It is a key instrument for the company to plan and analyze the situation with their assets, if they need to be renewed or big repairs are needed. The PP&E account can be recognized under the name of the net of accumulated depreciation. As a result, companies can see their net PP&E value slowly decreasing because of depreciation if they are neither purchasing additional equipment nor investing in their existing one.

Here is the formula for calculating Net PP&E:

$$Net\ PP\&E = Gross\ PP\&E + Capital\ Expenditures - Accumulated\ Depreciation$$

From the formula above Capital Expenditures can be seen (more frequently used as CapEx). When the company is investing in either updating existing equipment to increase the lifespan, or purchasing new additional equipment, this adds to the total PP&E balance on the balance sheet. (CFI s.a.)

4 IMPLEMENTATION

4.1 Cost estimation of welding equipment

First vital step is to analyze, what parts are considered when making a set of welding machine. The parts, which are going to be considered are: Power unit, Wire feeder, Trolley cart, MIG Torch, Earth return cable and Interconnecting cables.

According to IMT-Metatech Oy, the whole kit comes with the average price of 4 500 Euro, with an average lifespan of the 15 years. Thus, companies expect to use this equipment without any additional investments (not including the consumables) during all this period. However, according to the big brands such as Kemppi, they provide warranty service only for 3 years (Kemppi s.a.) but does this really mean that the useful life of the welding machines is only 3 years.

4.2 What depreciation method to use?

When thinking about choosing the depreciation method to use for equipment, it is important to understand the needs and what would be the most optimal way to depreciate. Firstly, it is important to allocate the methods, that can or cannot be used for the welding equipment. Out of all methods, mentioned in the theory before, the only one, which does not fit is the "Unit of production method". As this method benefits more for the equipment, which lifespan us calculated by the number of units it can produce rather than it's useful life. So it cannot be used with such equipment as MIG welding machines.

As a result, the only methods that are left to be used are "Straight line depreciation method" and "Declining balance method". And now it is important to understand, which one of those methods would benefit the most.

4.2.1 Straight line depreciation

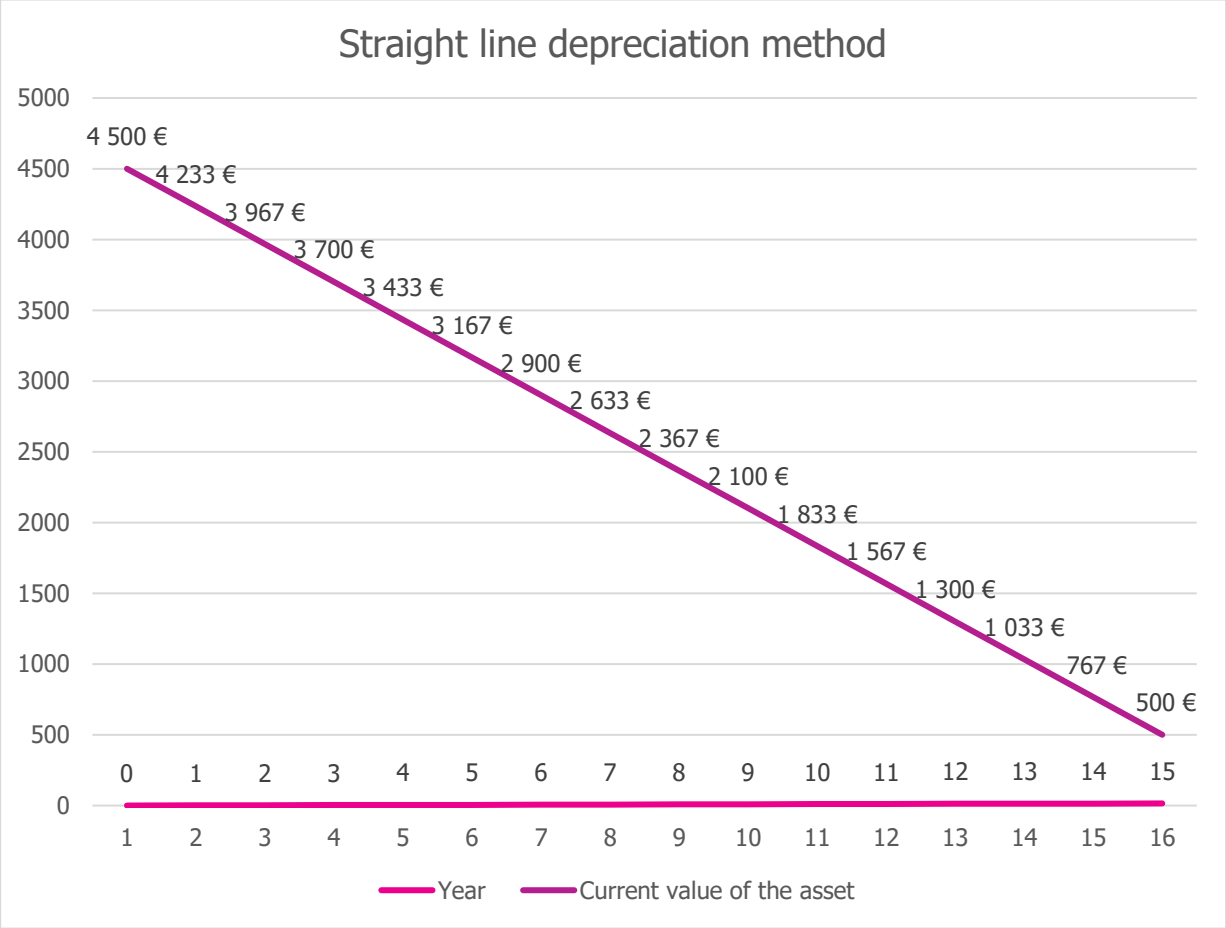
Straight-line depreciation method is the simplest method to implement. It gives possibility to reduce the value of the asset evenly throughout the years of its useful life. The only problem needs to be solved it to estimate the Scrap value of the asset. It can be solved easily with just a rough estimation of the scarp value, which won't be changeable in the future.

As a result, depreciation rate and depreciation deduction can be easily calculated with all the know parameters. According to Finnish tax administration, the maximum depreciation rate is 25% (Finnish tax administration 2023).

Here are the calculations for the straight line depreciation method based on information provided by the company, which were calculated according to the earlier mentioned formulas (all the formulas can be found in the paragraph 3.2.1). And in order to have a clear view of the straight line depreciation a graph is provided.

Investment cost	Salvage value	Estimated useful life of an asset	Depreciation deduction	Depreciation rate, %
4 500 €	500 €	15	267 €	6,7%

TABLE1. Straight line depreciation calculations (Mikhaylov 2024)



GRAPH 1. Straight line depreciation graph (Mikhaylov 2024)

Here is the data on basis of which the graph was made:

Year	Current value of the asset	Depreciation Deduction
0	4 500 €	
1	4 233 €	267 €
2	3 967 €	267 €
3	3 700 €	267 €
4	3 433 €	267 €
5	3 167 €	267 €
6	2 900 €	267 €
7	2 633 €	267 €
8	2 367 €	267 €
9	2 100 €	267 €
10	1 833 €	267 €
11	1 567 €	267 €
12	1 300 €	267 €
13	1 033 €	267 €
14	767 €	267 €
15	500 €	267 €

TABLE 2. Straight line depreciation data for the graph (Mikhaylov 2024)

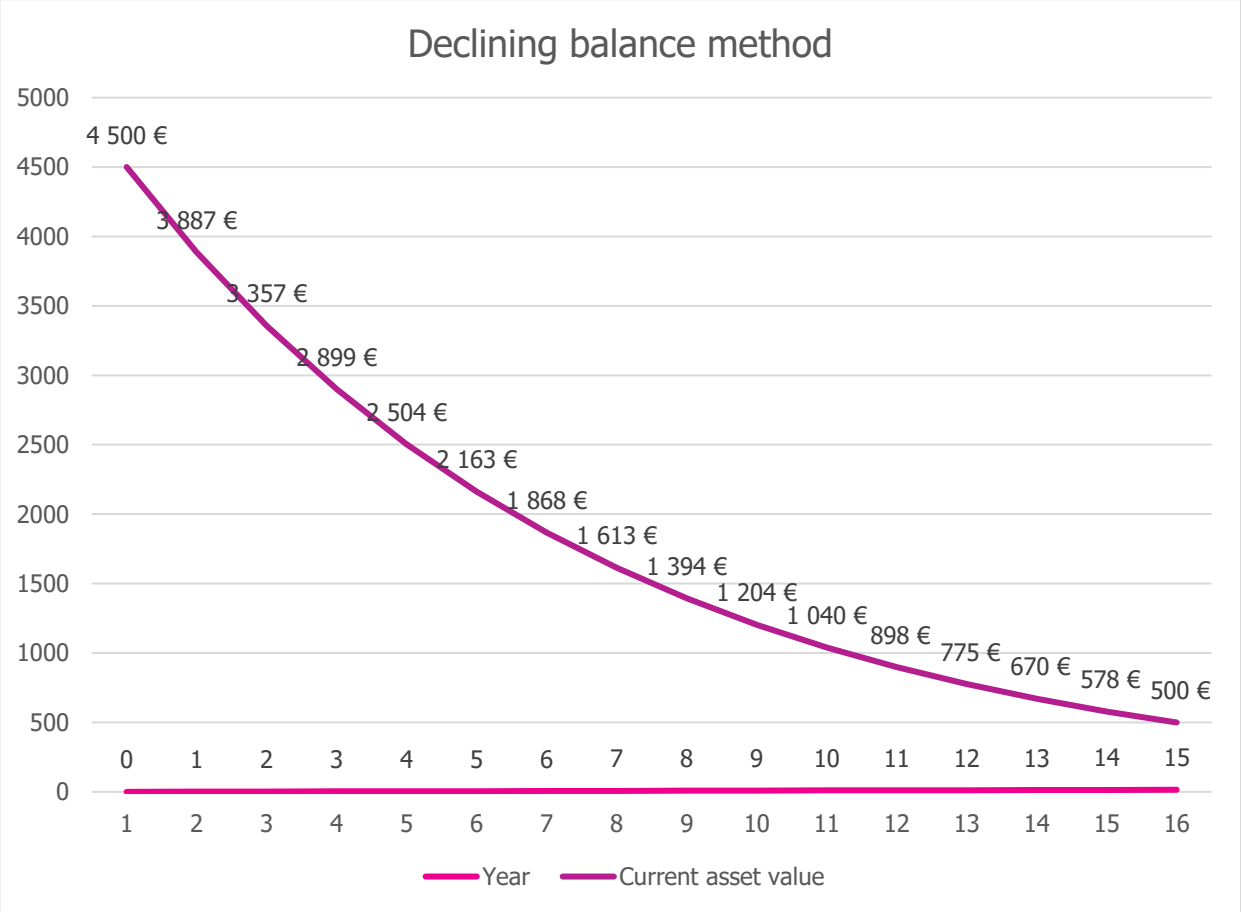
As it can be seen from the information presented above, the straight line depreciation method shows us, that the asset's value is equally reducing during the whole useful life of the asset. The current asset value can be observed for each period of time for the whole its useful lifespan. So, this method is the simplest method for the company.

4.2.2 Declining balance method

Declining balance method would be more interesting for the first years of using this method compared to the straight line method, as it would provide higher depreciation during the first years of depreciation period with further decrease in depreciation deduction amount.

Investment cost	Salvage value	Estimated useful life of an asset	Depreciation rate, %
4 500 €	500 €	15	13,6%

TABLE 3. Declining balance method data (Mikhaylov 2024)



GRAPH 2. Declining balance method graph (Mikhaylov 2024)

Here is the data on basis of which the graph was made:

Year	Current asset value	Depreciation Deduction
0	4 500 €	
1	3 887 €	613 €
2	3 357 €	530 €
3	2 899 €	458 €
4	2 504 €	395 €
5	2 163 €	341 €
6	1 868 €	295 €
7	1 613 €	255 €
8	1 394 €	220 €
9	1 204 €	190 €
10	1 040 €	164 €
11	898 €	142 €
12	775 €	122 €
13	670 €	106 €
14	578 €	91 €
15	500 €	79 €

TABLE 4. Declining balance method data for the graph (Mikhaylov 2024)

As it can be seen from the information presented above, Declining balance method shows that the value of the asset dramatically decreasing during the first 6 years at a much higher pace compared to the previous method described. Based on the data presented above, the declining of depreciable amount. It can benefit the company more during the beginning of implementation period.

5 CONCLUSION

Welding machines are complex pieces of equipment that are affected by many factors which can either increase or decrease their lifespan. Simply, if the welding equipment is used indoors or outdoors, it can affect the durability of the equipment. As well as weather conditions, which in shipbuilding industry are unpredictable, ~~and~~ welding equipment can be use done during very rough conditions.

As it can be observed from both graphs and provided data in the tables (mentioned in Graphs 2,4 and Tables 2,4), that the depreciation only reduces the value of the asset to the point, when it reaches the Scrap value. Companies can choose the method that fits and benefits their goals and strategy the most. Straight line depreciation method gives an opportunity to reduce the asset value evenly during its useful life, however the Declining balance method is helping to reduce the asset value at increased pace during the first years.

Understanding depreciation is essential, as it gives companies the opportunity to manage their assets more effectively. They can plan to get new equipment when they see how the value of the equipment is getting low. It not only provides simple data of the asset value, but with this information companies can develop strategies and optimize their business decisions.

Taking care of the lifespan of the welding equipment needs to be one of the main priorities when maintaining this kind of equipment. From the research that has been done on this topic, implementing daily inspections (before and after work) of welding equipment by the machine operators. It can prevent possible troubles with the machines and can act as a good preventive method. Can have positive impact on the production and warn about some failures in the machines in advance.

Also storing of welding machines can be taken to another level. As there is always dust and small particles of debris flying in the air on the construction site, it can cause some blockage in the hoses, problems with liners and other parts of the welding machine. There could be taken measures to improve the storage quality of the machines that are not being used. As an example, they can be covered with the tarp cover case or they can be stored in the sealed container/room, where the dirt, dust and debris have a hard way of getting in.

Collectively these simple methods can impact the lifespan of the welding machines in a positive way and can provide necessary treatment for the equipment with the effect on their efficiency in short and long term. As well as decrease the possible expenses on repairs and maintenance of the equipment.

By combining methods, both from depreciation and lifespan treatment, we are able to see the full picture of the current state of welding equipment, which gives us information on how really worn off the equipment is and if it needs to be renewed or repaired.

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