KOKKUVÕTE

Kaablikerade virnastaja projekteerimiseks koguti esmalt algandmeid nii kliendi tehase võimaluste kui ka ülesannete kohta, millega peab virnastaja hakkama saama. Kliendiga suheldes tehti projekteeritava masina tulevasele asukohale põhjalik analüüs. See vähendab potentsiaalseid probleeme ning kergendab masina integreerimist tehasesse. Pearaami konstruktsiooni valikul oli tähtsaimaks faktoriks robustsus. Valiti eraldiseisev raam, mis paikneb ümber konveieri. See muudab masina projekteerimise lihtsamaks ning edaspidi on sellist masinat kergem liinidesse integreerida. Lähtudes lühikestest liigutustest ning suure täpsuse mitte nõudmisest valiti pneumaatiline ajam. See teeb masina tootmise ja ka hooldamise lihtsaks ja odavaks.

Tööriistaks valiti lahendus, mis sarnaneb kihvadele. Selle eelisteks oli odavus valmistamisel, töökindlus ja sobilikkus erinevatele toodetele. Kihvad on projekteeritud nii, et need upuvad rullkonveieri rullide vahele. See suurendab omakorda töökindlust ja vähendab kahju kaablikeradele. Tööriist disainiti modulaarseks ehk kihvad on võimalik asendada labidaga. See võimaldab masinat kasutada ka koos lintkonveieriga. Pärast tööriistade ja stopperite disainimist tehti tugevusarvutus raami kandeplaadile. Kontrolli teostamisel selgus, et plaat on üle dimensioneeritud. Materjali kulu vähendamiseks optimeeriti plaadi mõõte.

Masina töö kindlaks toimimiseks arvutati käsitsi välja sobivad pneumaatilised silindrid ja kontrolliti tulemust Festo kataloogist. Virnastaja koostamiseks joonistati pneumaatikaskeem. Liigse õhukulu vastu on lisatud pneumaatikaplokki rõhuregulaatrid, millega saab õhukulu vähendada. Masina automatiseerimiseks valiti sobivad andurid. Programmeerijate töö lihtsustamiseks koostati loogikaskeem, kus on näidatud liikumiste järjekord ning kust saadakse vajalikud signaalid. Selleks, et töö mööduks ilma õnnetuste ja seisakuteta tehti riskianalüüs, millest selgus, et juhiste järgimisel on tööõnnetuste riskifaktor väga madal. Selgesti arusaadava ohutusjuhendi koostamiseks kirjutati välja kõik nõuded masinaga opereerimiseks.

Lõputöö tulemuseks on robustse disainiga kaablivirnastus masin. See on uus lisafunktioon firma poolt pakutatavates kaablikerimisliinides. Masinat saab paigaldada ka juba eelnevalt tellitud liinidele. Seoses oma robuste disaini ja korralikult teostatud hooldusega on tegu väga töökindla lahendusega, mis aitab liinil valmivat toodangut odavamalt pakendada. Odavusele lisaks kasutatakse ka seeläbi vähem pakkimiskilet, mis muudab toote loodussõbralikumaks.

Lõputöö autor on enda projekteeritud masinaga väga rahul. Järgnevalt tuleb teostada katseid reaalse masinaga, et avastada üle- ja aladimensioneeritud detaile. Lisaks detailide optimeerimisele saab toote hinda alandada ka suuremaid partiisi tellides. Selleks on vaja muuta masinat veelgi modulaarsemaks. Autori arvates on väga kasulik muuta firma toodangut modulaarsemaks, sest see vähendab edaspidi projekteerimisosakonna koormust ning muudab tootmist odavamaks ja lihtsamaks.

SUMMARY

To design the cable reel stacker, initial data was first collected regarding both the capabilities of the client's factory and the tasks the stacker has to execute. When interacting with the client, the future location of the machine to be designed was thoroughly analysed. This reduces potential problems and facilitates the integration of the machine into the factory. The selection of the construction of the main frame was based on its robustness. A separate frame was selected which is situated around the conveyor. This makes designing the machine easier and, in the future, it will be easier to integrate the machine into the lines. Based on the short movements and the fact that high accuracy is not required, a pneumatic actuator was selected. This makes the production and maintenance of the machine easy and inexpensive.

The selected tool is a solution similar to flanges. Its advantages were the fact that it is cheap to manufacture, reliable, and suitable for different products. The flanges are designed to sink between the rollers of the conveyor. This, in turn, increases reliability and reduces the damage done to the cable reels. The tool was designed to be modular, i.e. the flanges can be replaced with a spade. This allows the machine to be used with a belt conveyor as well. After designing the tools and stoppers, a strength analysis was carried out on the pallet of the frame. The inspection revealed that the pallet was over-dimensioned. The measurement of the pallet was optimized to reduce the material cost.

To ensure the operation of the machine, the suitable pneumatic cylinders were manually calculated and the result was checked against the Festo directory. To put together the stacker, a pneumatic schema was drawn up. Pressure regulations have been added to the pneumatic block to combat excess air, which can reduce air delivery. Suitable sensors were selected to automate the machine. To simplify the work of programmers, a logic scheme was developed which indicates the sequence of movements and the sources of the necessary signals. In order to avoid occupational accidents and stoppages, a risk assessment was carried out, which revealed that if the instructions are followed, the risk factor for occupational accidents is very low. To compile clearly understandable safety instructions, all requirements for the operation of the machine were written down.

The result of the thesis is a cable reel stacker with a robust design. This is a new additional function in the cable coiling lines offered by the company. The machine can also be installed on pre-ordered lines. Thanks to its robust design and proper maintenance, it is a very reliable solution which enables cheaper packaging of the production on the line. In addition to the cheapness, less packing film is used, which makes the product more environmentally friendly.

The author of the thesis is very satisfied with the designed machine. Now, tests must be carried out on a real machine to detect over- and under-dimensioned details. In addition to optimising details, the price of the product can also be lowered by ordering larger batches. To do this, the machine must be made even more modular. In the author's opinion, it is very useful to make the company's production more modular, because this will reduce the burden of the design department and make production cheaper and easier.