Darko Lovrec

Zeleni dotik fluidne tehnike

Fluidna tehnika in trajnost

Kako zelena je moja hidravlika?

NAČRT ZA OKREVANJE IN ODPORNOST
Univerza v Mariboru
REPUBLIKA SLOVENIJA
MINISTRSTVO ZA VISOKO ŠOLSTVO, ZNANOST IN INOVACIJE
Financira Evropska unija
NextGenerationEU

1

Za uvod

Kako zeleno je zeleno?
Kako razumeti trajnost?
Kaj pravi Evropska agencija za okolje?
Mednarodna konferenca 14-IFK in trajnost
Današnja vsebina

2

Kako zeleno je zeleno in kaj vse je zeleno?

3

Kako zeleno je zeleno in kaj vse je zeleno?

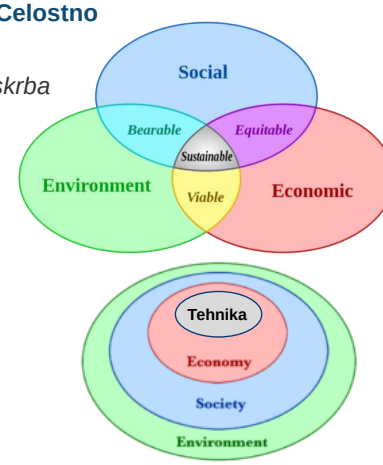
Knjige in učbeniki: Zelena energija, Marketing zelene šole, Zeleni biznis, Zeleno učenje, Zelena tehnologija, Zeleno pravo, Zeleni zakoni narave…

4

Trajnost ali trajnostnost ali…? Sopomenki ali kaj več?

Trajno **Trajnost** **Sonaravno** **Zeleno** **Nizkoogljično** **Ekološko**
Trajnostno **Trajnostnost** **Okoljsko** **Brezogljično** **Celostno**

… z namenom dolgoročnega ohranjanja, da čim manj obremenjuje okolje, glede na razpoložljive naravne vire: trajnostni razvoj, turizem, trajnostna oskrba s hrano, z energijo, trajnostno gospodarjenje



Mnenje Terminološke sekcije SAZU:
Razmerje med terminoma *trajnostni razvoj* in *sonaravni razvoj*:
V Tehniškem metalurškem slovarju termin *trajnostni razvoj* označuje "razvoj, ki zadovoljuje osnovne potrebe vseh ljudi na Zemlji in ohranja, varuje ter obnavlja zdravje ter celovitost ekosistemov, in je v mejah, ki jih narava še lahko prenese".

Izraz sonaravni razvoj ustreza angleškemu izrazu *sustainable development*.
Slovar kot sopomenki navaja *sonaravni razvoj* in *sonaravni trajnostni razvoj*; nemški ustreznik je *nachhaltige Entwicklung*.

Trajnost in trajnostno? Sopomenki ali kaj več?

Leksikon Geografija (Kladnik 2002: 560): termina *trajnostni razvoj* in *sonaravni razvoj* opredeljena kot sopomenki.
Geografski terminološki slovar: med terminoma ni sopomenskega razmerja.

Trajnostni razvoj je definiran kot 'razvojna usmeritev človeške družbe, usklajena, uravnotežena z naravnimi razmerami, ki ohranja okolje, naravne vire za prihodnost', *sonaravni razvoj* pa kot 'razvoj človeške družbe, zlasti gospodarski, skladen z naravo, pokrajino, njuno zmogljivostjo'. Iz definicij ne moremo razbrati razlik med pojmoma, ki ju označujeta oba termina.

Zelena transformacija je orodje, glavni cilj pa preživetje ...

Zelena prenova oz. **transformacija** je orodje in ne glavni cilj - in tega se moramo zavedati, tako kot se moramo zavedati dejstva, da gre za dolgoročno strategijo in usklajene aktivnosti.

Trajnost ali trajnostnost? Sopomenki ali kaj več?

Trajnostnost (ang. *sustainability*) oz. *načelo trajnostnosti* (ang. *concept of sustainability*)

Angleškemu pridevniku *sustainable* v slovenskih terminih pogosto ustreza pridevnik *trajnostni* (npr. *sustainable development – trajnostni razvoj*, *sustainable mobility – trajnostna mobilnost*, *sustainable energy – trajnostna energija*). >>

Sustainable Fluid Power / Trajnostna fluidna tehnika >> Fluidna tehnika in trajnost

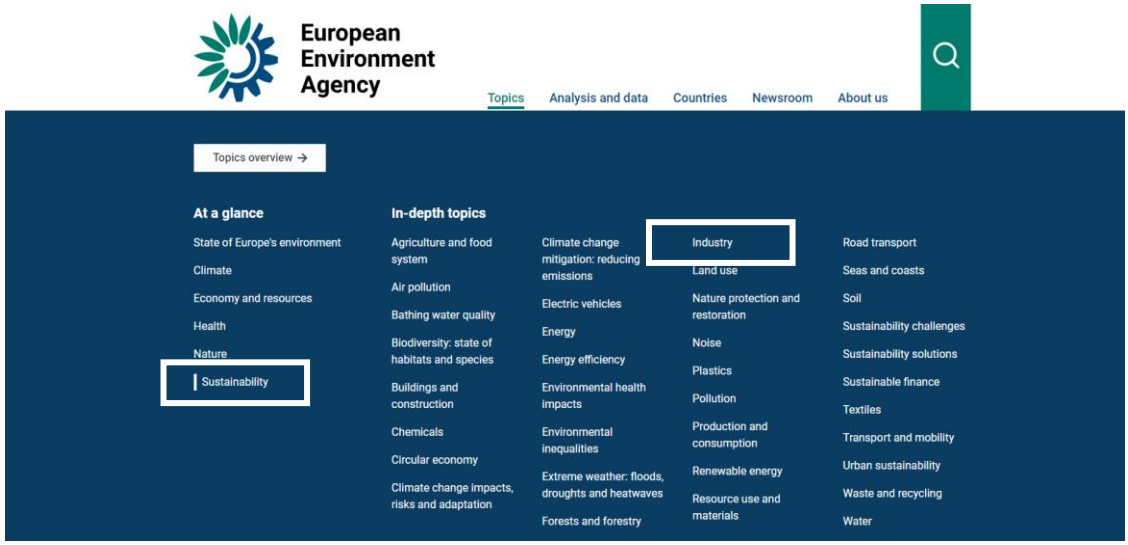
Pri nemškem izrazu "Zukunftsfähigkeit", oz. širše uporabljanem izrazu Nachhaltigkeit (= trajnost) naletimo na naslednje možne prevode in razlage:

- **odpornost na izzive prihodnosti,**
- **prihodnja sposobnost preživetja,**
- **sposobnost za obstoj v prihodnosti,**
- **dolgoročna vzdržnost…**

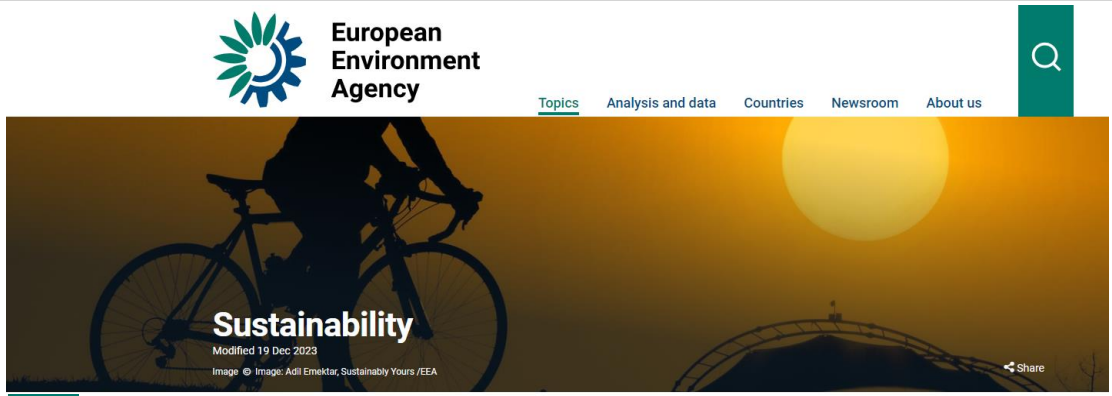
REPUBLIKA SLOVENIJA
GOV.SI

Načrt za okrevanje in odpornost

Evropska agencija za okolje EEA

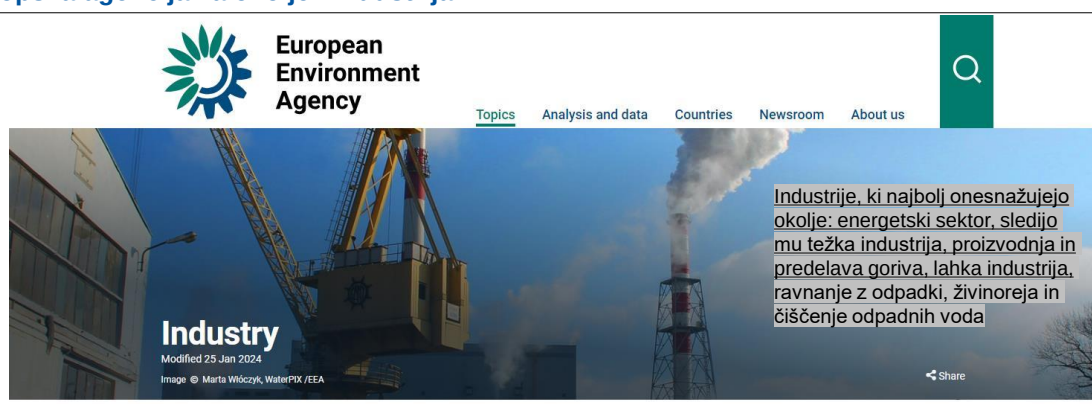


Evropska agencija za okolje - Trajnost



Trajnost ni zadovoljevanje samo današnjih, temveč tudi jutrišnjih svetovnih potreb z ustvarjanjem sistemov, ki nam omogočajo, da živimo dobro in v mejah našega planeta, zato gradnja trajnostne Evrope ni lahka naloga. Brez hitre in temeljne preobrazbe evropskih proizvodnih in potrošniških sistemov ne bo mogoče. Evropa mora najti načine za spremembo ključnih sistemov ne samo hrane, energije, mobilnosti in stavb, temveč tudi premislek o tehnologijah, proizvodnih procesih, potrošniških vzorcih in našem načinu življenja

Evropska agencija za okolje - Industrija



Evropska komisija je marca 2020 predstavila in leta 2021 posodobila industrijsko politiko, ki podpira zeleni in digitalni prehod, naredila industrijo EU bolj konkurenčno na svetovni ravni in okrepila odprto strateško avtonomijo Evrope. EU kot del Evropskega zelenega dogovora je skladna z glavnim ciljem ustvarjanje podnebno nevtralnega, krožnega in čistega gospodarstva ter širšimi cilji nič onesnaževanja in okolja brez strupenih snovi. Tem ciljem sledimo tudi na področju Fluidne tehnike, predvsem hidravlike.

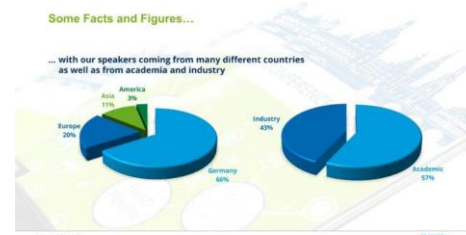
O svetovni konferenci International Fluid Power Conference 2024 – 14-IFK

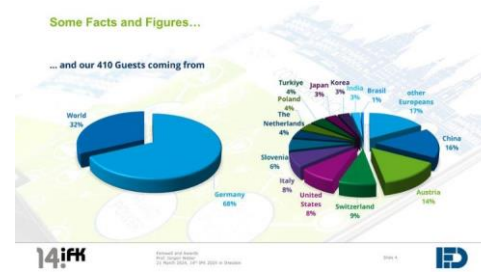
Fluid Power
Sustainable Productivity

14.IFK
14th International Fluid Power Conference
March 19 -21, 2024 in Dresden

410 udeležencev

- 24 scientific sessions on
- 22 different topics with
- 91 talks including
- 3 general lectures
- 4 Keynotes





O svetovni konferenci International Fluid Power Conference 2024 – 14-IFK

Tematske sekcije:

Materiali, Hidravlične tekočine, Tribologija, Črpalke, Ventili, Mobilne aplikacije, Novi in posebni primeri uporabe, Trajnostna pnevmatika, Regulacije, Načrtovanje in arhitektura sistemov, Simulacije, Digitalizacija, Vodik in hidravlika…

KEYNOTES

Wednesday, March 20, 2024, at 9:15 a.m.

All Keynotes take place in the main conference room (Audimax)

Intelligent mobile machines contribute to productivity and sustainability of construction sites
Jürgen Weber, TU Dresden
Luisa Bindel, STRABAG AG

Wednesday, March 20, 2024, at 10:00 a.m.

Data management in fuid power technology
Steffen Haack, Bosch Rexroth AG
Ansgar Kriwet, Festo SE
Hartmut Rauen, VDMA

Sustainable Fluid Power
Jeff Herrin, Danfoss Power Solutions

Thursday, March 21, 2024, at 10:00 a.m.

Decarbonization @Liebherr
Stefan Peters, Liebherr-EMtec GmbH

Potencial na področju opreme in sistemov fluidne tehnike

Vsebina - 1

1. **Konferenca 14-IFK in vidik trajnosti**
   - ❖ **Trajnost z vidika uporabnika opreme: Inteligentna mobilna hidravlika prispeva k produktivnosti in trajnosti, doseganje klimatske nevtralnosti podjetja Strabag AG do leta 2040**
   - ❖ **Trajnost z vidika proizvajalca opreme: Dekarbonizacija in podjetje Liebherr**
   - ❖ **Trajnost z vidika strokovnih združenj: CETOP, NFPA in smernice razvoja fluidne tehnike**

Potencial na področju opreme in sistemov fluidne tehnike

Vsebina - 2

2. **Primeri rešitev za izboljšanje učinkovitosti komponent in sistemov v hidravliki**
   - ❖ **Energetsko učinkoviti pretvorniki energije**
   - ❖ **Materiali in izboljšanje učinkovitosti komponent fluidne tehnike**
   - ❖ **Hidravlične tekočine za večjo trajnost**
   - ❖ **Primeri s področja mobilne hidravlike**
   - ❖ **Trajnost na področju pnevmatike**
   - ❖ **Uporaba simulacij za namene povečanja energetske učinkovitosti komponent**

- ❖ **Arhitektura sistemov in koncepti vodenja za povečanje trajnosti fluidne tehnike**
- ❖ **Aplikacije za bolj zeleno prihodnost**

Potencial na področju opreme in sistemov fluidne tehnike

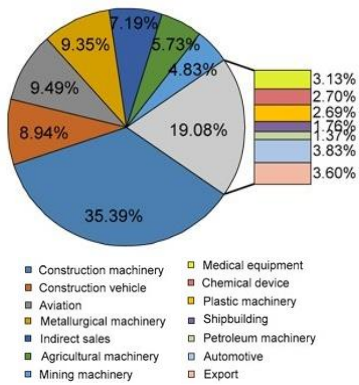
Vsebina - 3

3. **Kako dalje? Naslednji koraki**
4. **Prispevek slovenskih raziskovalcev k povečanju energetske učinkovitosti in trajnosti**
5. **Zaključna misel – kaj nas čaka v bližnji prihodnosti?**
6. **Videnje problematike slovenskih uporabnikov: mnenja-pripombe…**

Potencial na področju opreme in sistemov fluidne tehnike

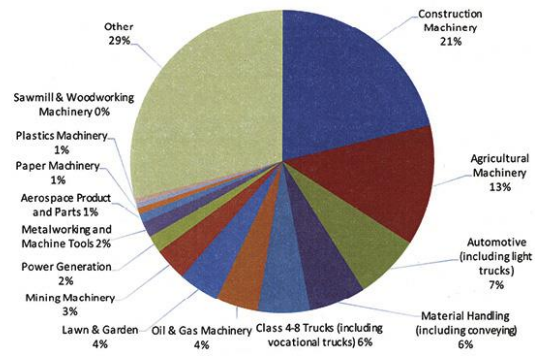
Zakaj je bil v ospredju poudarek na področju mobilne hidravlike?

China in 2010



Vir: Distribution of application areas of hydraulic machines in China in 2010

Hydraulic Total Sales - 2017 Data

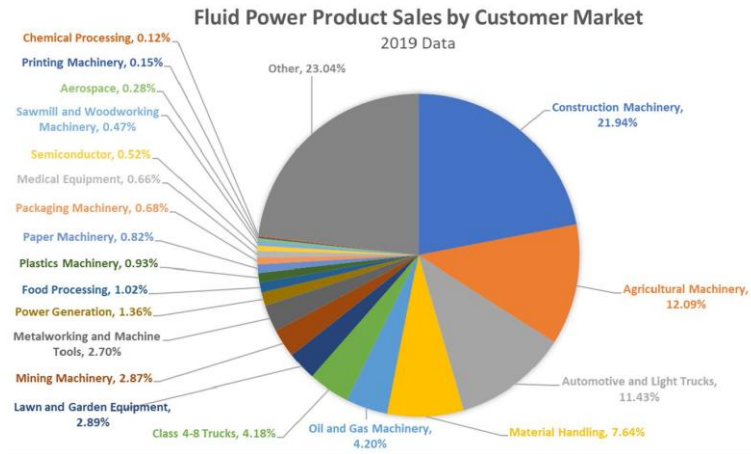


Vir: National Fluid Power Association (NFPA)

Potencial na področju opreme in sistemov fluidne tehnike

Zakaj je v ospredju poudarek na področju mobilne hidravlike?

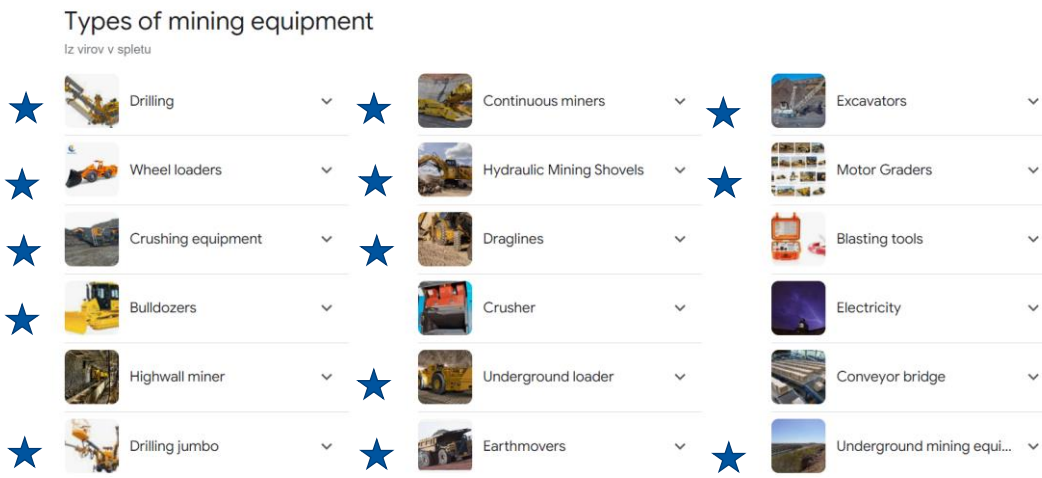
Proizvodi področja mobilne hidravlike predstavljajo približno polovico vseh proizvodov segmenta



Vir: NFPA

Potencial na področju opreme in sistemov fluidne tehnike

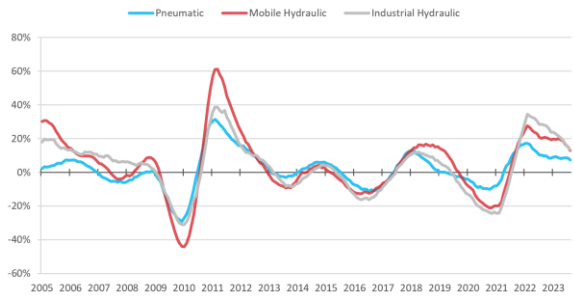
… vključujoč področje strojev v rudarstvu



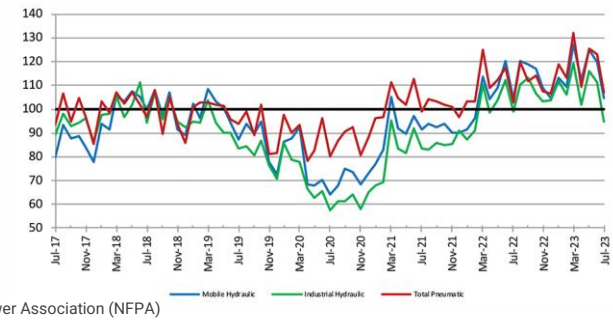
Potencial na področju opreme in sistemov fluidne tehnike

Zakaj je v ospredju poudarek na področju mobilne hidravlike?

Shipments: Pneumatic, Mobile Hydraulic, and Industrial Hydraulic
Index Data: 12/12 Rate of Change



Hydraulic and Pneumatic Shipments
Raw Index Data
Index: 2018=100



Vir: National Fluid Power Association (NFPA)

1.0 Stanje fluidne tehnike in smeri razvoja

1. **Konferenca 14-IFK in vidik trajnosti**
   - ❖ **Trajnost z vidika uporabnika opreme: Inteligentna mobilna hidravlika prispeva k produktivnosti in trajnosti, doseganje podnebne nevtralnosti podjetja Strabag AG do leta 2040**
   - ❖ **Trajnost z vidika proizvajalca opreme: Dekarbonizacija in podjetje Liebherr**
   - ❖ **Trajnost z vidika strokovnih združenj: CETOP in NFPA: smernice razvoja fluidne tehnike**

Trajnost z vidika uporabnika opreme; podjetje STRABAG AG

Sustainability strategy at STRABAG

How STRABAG will become climate neutral by 2040 with active carbon reduction

Trajnost z vidika uporabnika opreme fluidne tehnike – STRABAG AG

Luisa Bindel
Strabag AG
Prof. Dr.-Ing. Jürgen Weber
TU Dresden | Chair of Fluid-Mechatronic Systems, Germany

Intelligent mobile machines contribute to productivity and sustainability of construction sites

Inteligentna mobilna hidravlika prispeva k produktivnosti in trajnosti oz. doseganje podnebne nevtralnosti podjetja STRABAG AG do leta 2040

Kako bo STRABAG postal podnebno nevtralen do leta 2040 z zmanjšanjem aktivnega ogljika?

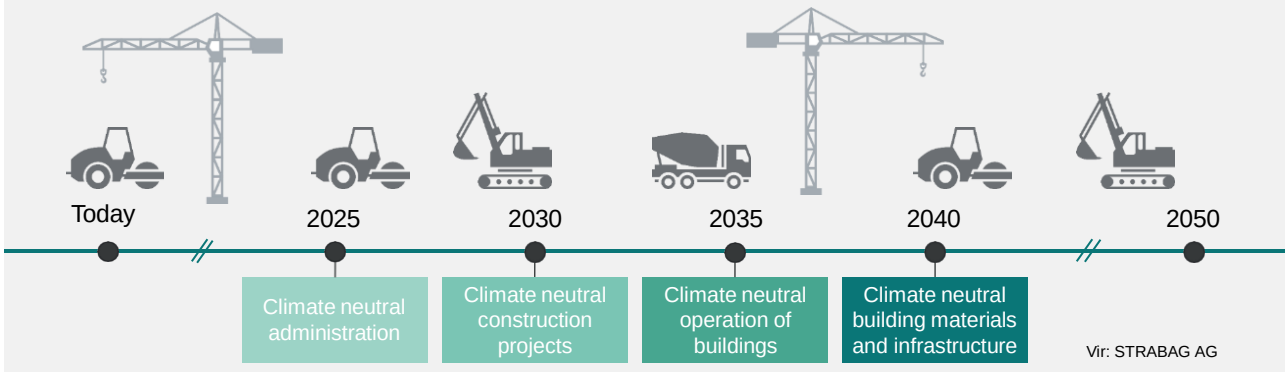
Vir: STRABAG AG

STRABAG AG – pot do podnebne nevtralnosti

Luisa Bindel; Strabag AG

Podnebna nevtralnost se nanaša na zamisel o doseganju ničelnih neto emisij toplogrednih plinov z uravnoteženjem teh emisij, tako da so enake (ali manjše) emisijam, ki se odstranijo z naravno absorpcijo planeta

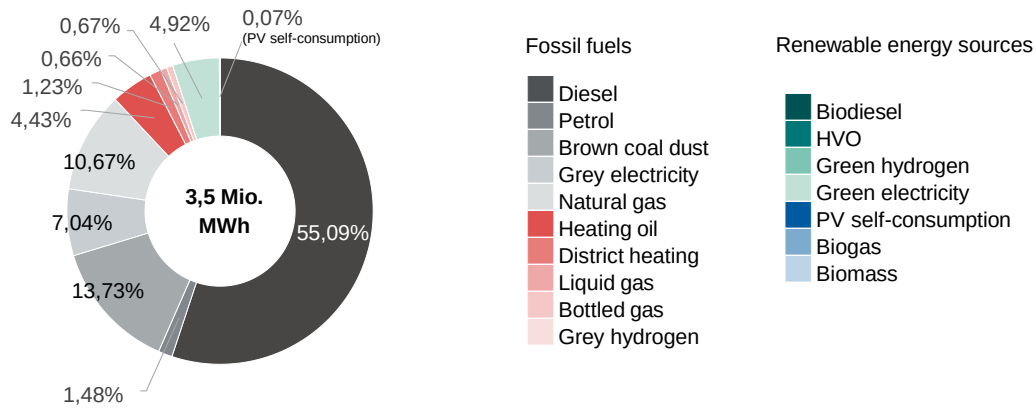
STRABAG has set itself the goal of becoming climate neutral along the entire value chain by 2040.



Vir: STRABAG AG

STRABAG AG – energija in dekarbonizacija

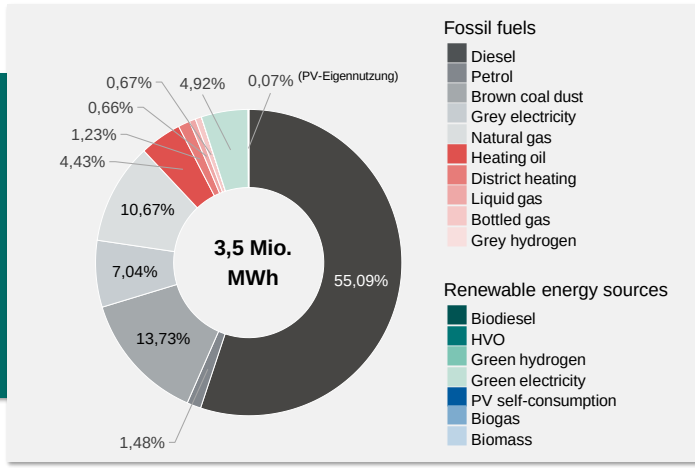
Deleži porabe energije v 2022



Vir: STRABAG AG

STRABAG AG – energija in dekarbonizacija

Trenutna poraba energija



Our business activities are currently 95 % fossil.

But we want more green areas in the pie chart!
How can we achieve this?

Vir: STRABAG AG

STRABAG AG – energija in dekarbonizacija

Alternativni viri energije:

HVO

- No new purchase of devices necessary → Inventory can be used
- Availability of green HVO on the market is limited
- Pilot projects in infrastructure construction

Electricity

- Small to medium-sized e-construction machines in use
- Electricity mix used affects the level of sustainability
- Internal testing of large machines with regard to their suitability for use in construction operations

Hydrogen

- Large machinery only partially available on the market
- Availability of green hydrogen limited and development of charging infrastructure challenging
- Internal evaluation of the use of H2 devices ongoing

Vir: STRABAG AG

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Trenutno stanje digitalizacije:

MULTIPLE DATA SOURCES

There are many data sources such as:

- Machine manufacturers
- Control manufacturers
- Sensor and device manufacturers

DATA COLLECTION AND COMBINATION

The ability to combine data is limited.

A lot of data is collected multiple times and hardware is installed multiple times.

ACCESSIBILITY

Machine data is often not accessible or only accessible to a limited extent.

As a result, the machine data can hardly be processed any further and external solutions are used to collect machine-related processes.

Vir: STRABAG AG

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Zakaj potrebujemo vse te podatke?

Planning

For example:

- Planning on the basis of historical data
- Best possible use of equipment also with regard to eco-efficiency
- Construction scheduling

Building

For example:

- Recording of all machine-related activities, consumption, capacity utilization and CO_2 footprint
- Record freight & bulk movements
- Visualization of logistical processes

Accounting

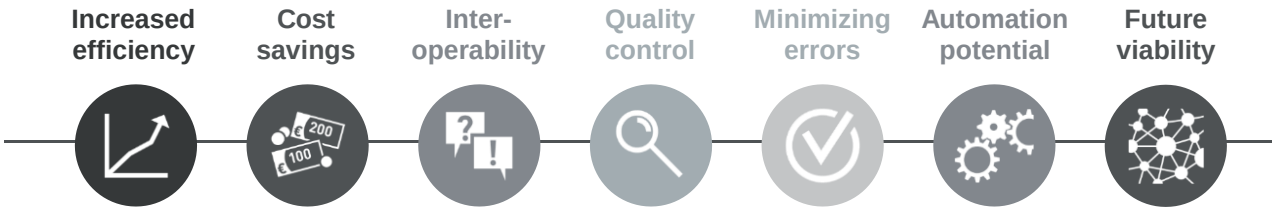
For example:

- Automatic transport documents
- Billing reporting by m^3, loads or weight
- Machine life cycles

Vir: STRABAG AG

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Zakaj potrebujejmo standardizacijo?



Increased efficiency
Standardized machine data can be used to optimize production processes and thus increase their efficiency.

Cost savings
Reduced time spent on integrating and analyzing different data formats.

Inter-operability
Standardized machine data supports interoperability between different construction machines and equipment from different manufacturers.

Quality control
Standardized quality assurance with standard as a fixed point. As well as simplifying the analysis of construction projects using advanced data analysis techniques.

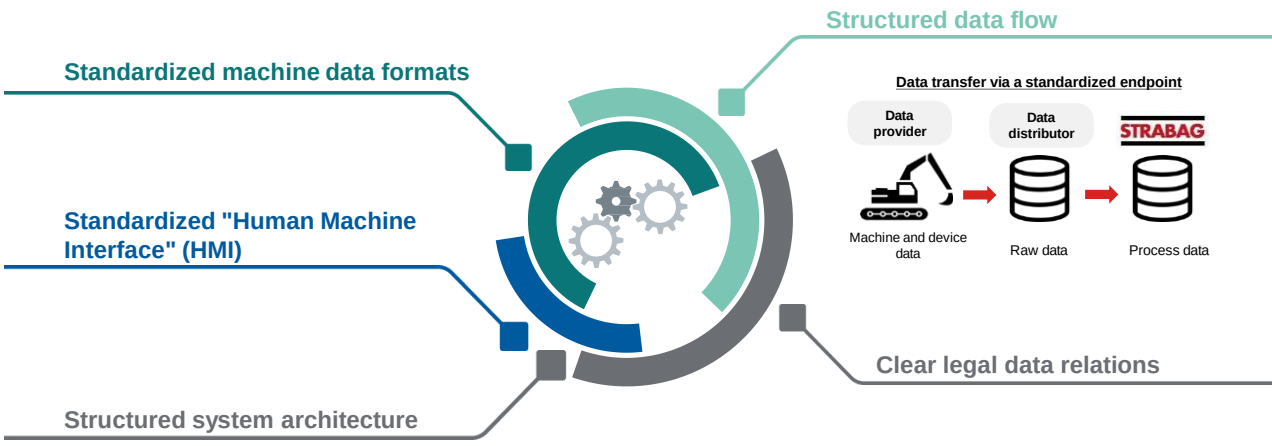
Minimizing errors
Simplified fault detection and correction during the construction process, resulting in fewer failures, delays and additional costs.

Automation potential
With standardized machine data, construction companies can implement automated processes.

Future viability
The standardization of machine data lays the foundation for innovations in the construction industry by facilitating the integration of new technologies and the development of new business models.

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Zahteve:



Vir: STRABAG AG

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Prof. Juergen Weber; TU Dresden

It is clear what the requirements, are question is:
How to contribute to solutions?

… let's get the terms straight

Intelligent mobile machines contribute to

productivity and

sustainability of construction sites

Vir: TU Dresden

STRABAG AG – digitalizacija…

… let's get the terms straight

Intelligent mobile machines contribute to

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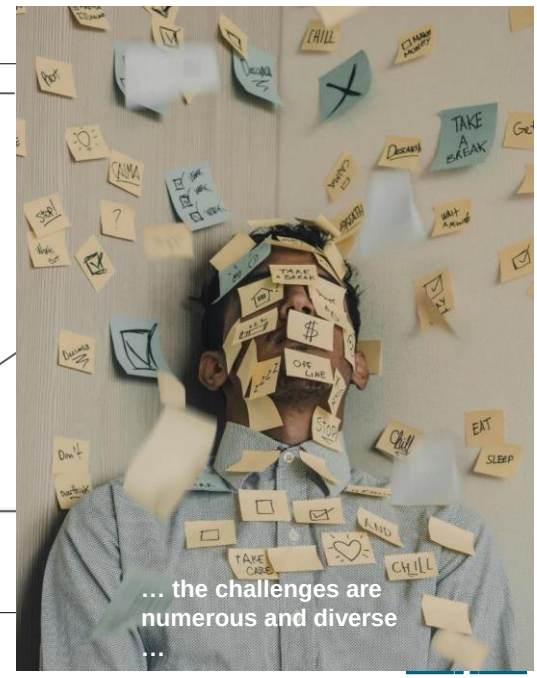
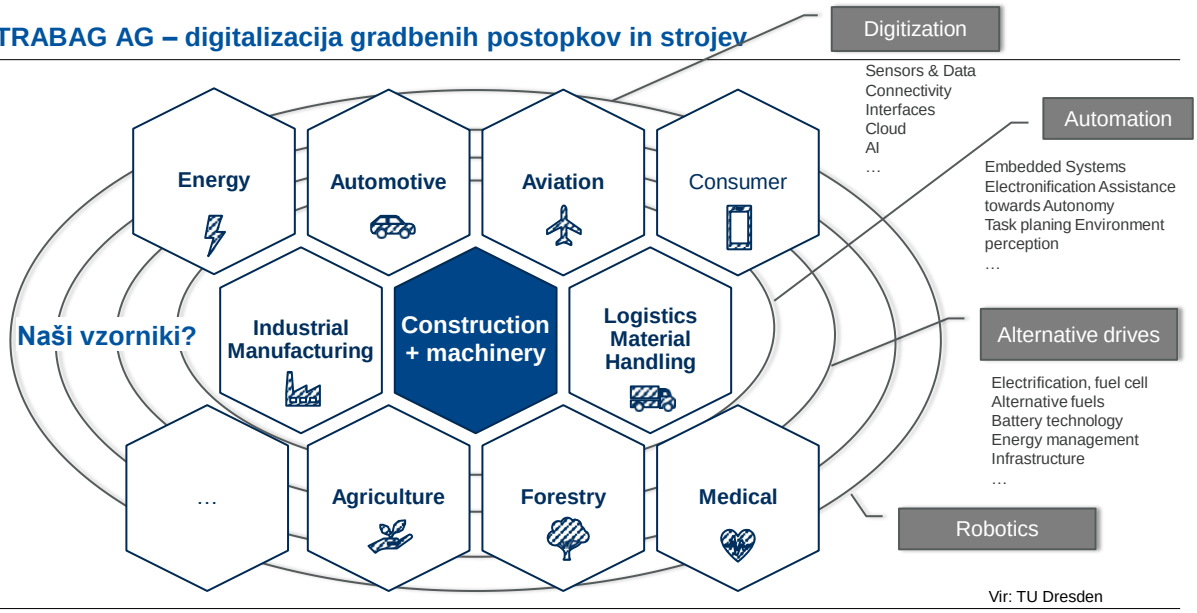


Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

STRABAG AG – digitalizacija gradbenih postopkov in strojev

STRABAG AG – digitalizacija gradbenih postopkov in strojev



Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Vzornik za naše področje: Digitalizacija v kmetijstvu

Characteristics Agriculture:

- Off-Road Machinery with a variety of specific attachments
- **strongly process-driven** – farmers need data for farm management
- existing standard **fieldbus communication** (ISOBUS since 2001)

Obstacles of this role model for Construction:

- Almost none – but …
- There is no existing standard for communication
- The challenge is to establish a **community of interest** and **collaboration**

Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Characteristics Construction:

- **Highly mixed fleets** and technologies
- Mostly **proprietary communication protocols**
- **No standardized data models** or **interfaces**
- significantly more diverse system architecture with a **high number** of **interfaces**

Approach:

- Usage of **interoperability technologies** like OPC UA
- Founding and establishing communities for **industry-coordinated data models** like MiC4.0
- **Collaboration** between **OEMs** and **construction companies**
- Support through **joint research projects** like “Bauen 4.0”

Digitalizacija v gradbeništvu – arhitektura sistema

https://www.youtube.com/watch?v=GJdWygdklJY

Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Vzornik: Avtomatizacija v proizvodnji

Characteristics Manufacturing:

- **Process sequences** reproducible/repetable
- **No variation** in process sequences
- **Defined**, **Non-variable ambient conditions**
- “They do the pre-defined task again and again and …” -> Best Case for Automation

Obstacles of this role model for Construction:

- Which task is **suitable for automation**?
- Are the **technologies ready for outdoor**?
- Do we get the **technology costs** in relation to the target industry?

Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Avtomatizacija v gradbeništvu

Characteristics Construction:

- Outdoor and heavy-duty
- **No tasks seems to be the same**
- **No closed areas of movement** -> Safety issue
- **Mixed fleet operation** (old and new, already more automated machines)

Approach:

- **Assistance systems like 3D machine control system** from Leica, Trimble, Topcon, MTS, Moba are already state-of-the-art
- **Higher automation levels** are coming like **in road construction** or **from research**

Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Vzornik: Alternativni pogoni v osebnih vozilih

Characteristics Automotive:

- Extremely **high volume of products/units**
- **Existing charging infrastructure**
- **Suitable battery technology** and according **production capacity**

Obstacles of this role model for Construction:

- No adequate charging infrastructure
- **Wide range of performance classes** and **machine sizes**
- **External mechanical load** on the **battery pack**

Vir: TU Dresden

STRABAG AG – digitalizacija gradbenih postopkov in strojev

Alternativni pogoni pri gradbenih strojih

Characteristics Construction:

- **High energy demand**
  and high power and torque due to the work task
  -> Availability of components ?
- Energy Efficiency vs productivity
  -> Availability for 8-hour shift/working day
- **Low volumes** and **high cost pressure**

Approach:

- **Battery-Electric machines** (small to medium-sized) **are already on the market**
- other technologies like **hydrogen / alternative fuels** are under investigation
- **Energy efficient hydraulics** are back in vogue like **displacement control** or **independent metering** as well as **hybridization**

Vir: TU Dresden

STRABAG AG in TU Dresden – sklep: Preobrazba v trajnost in povečanje produktivnosti

Summary of user requirements or strategy of construction companies:

- ❖ **Sustainability is a strategic topic for construction companies in all their processes**
- ❖ **Increase of productivity is a major topic / high importance**
- ❖ **Efficient use of resources and technology contributes in parallel to sustainability and productivity**
- ❖ **Digitization is seen as an fundamental technology/methodology**
- ❖ **Especially the end-to-end / universal availability of data and information**

Vir: TU Dresden

STRABAG AG in TU Dresden – sklep: Preobrazba v trajnost in povečanje produktivnosti

Key topics for an successfully approach:

- **Digitization** is a key for our technology in all processes, but it is important
  - to provide the relevant data
  - in the appropriate and reliable quality
  - for the right stakeholder

- **Automation** contributes to higher productivity and directly to sustainability
  - as ratio of reduced recourses vs result/product

- **Alternative Drives**
  - Electrification (battery-electricity) for medium and large machines is still an open topic
  - There is a need to keep open mind for the wide range of technologies and architectures

Vir: TU Dresden

STRABAG AG – sklep: Preobrazba v trajnost in povečanje produktivnosti

Trajnost z vidika proizvajalca opreme; podjetje Liebherr AG

Trajnost z vidika proizvajalca opreme – Liebherr AG

Trajnost z vidika proizvajalca opreme – Liebherr AG

Liebherr and the Energy Transition

The Liebherr Group plays **two major roles** in the **global transformation** to a **decarbonized economy**:

- **Liebherr equipment** and **components** enable the supply of the raw materials and the development of infrastructure to make the **energy transition** possible.
- Many Liebherr machines are **characterized** by fossil fuel based power trains, high-power requirements and continuous operation, making them **significant emitters of CO_2**.

Trajnost z vidika proizvajalca opreme – Liebherr AG

Liebherr and the Energy Transition

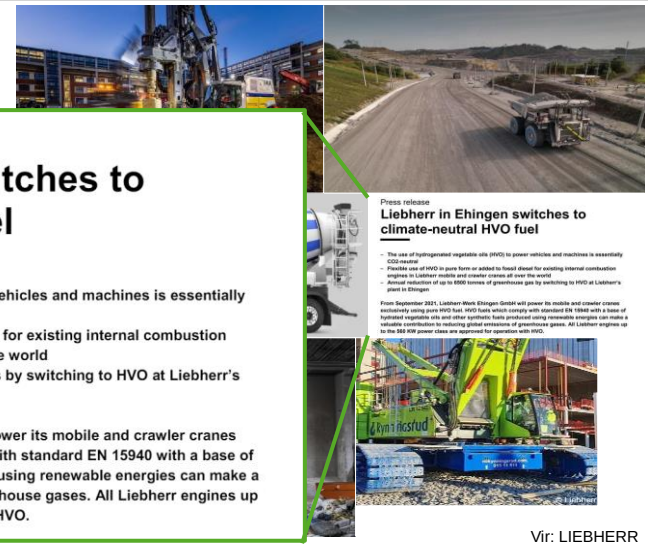
Liebherr has made significant progress in the development of low and zero-emission technologies across its wide product range.

With future generations in mind, we continue to invest significantly in innovations that are both good for our customers and good for the planet.

Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG

Liebherr low and zero- emission technologies



Press release

Liebherr in Ehingen switches to climate-neutral HVO fuel

- The use of hydrogenated vegetable oils (HVO) to power vehicles and machines is essentially CO2-neutral
- Flexible use of HVO in pure form or added to fossil diesel for existing internal combustion engines in Liebherr mobile and crawler cranes all over the world
- Annual reduction of up to 6500 tonnes of greenhouse gas by switching to HVO at Liebherr's plant in Ehingen

From September 2021, Liebherr-Werk Ehingen GmbH will power its mobile and crawler cranes exclusively using pure HVO fuel. HVO fuels which comply with standard EN 15940 with a base of hydrated vegetable oils and other synthetic fuels produced using renewable energies can make a valuable contribution to reducing global emissions of greenhouse gases. All Liebherr engines up to the 560 KW power class are approved for operation with HVO.

Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG

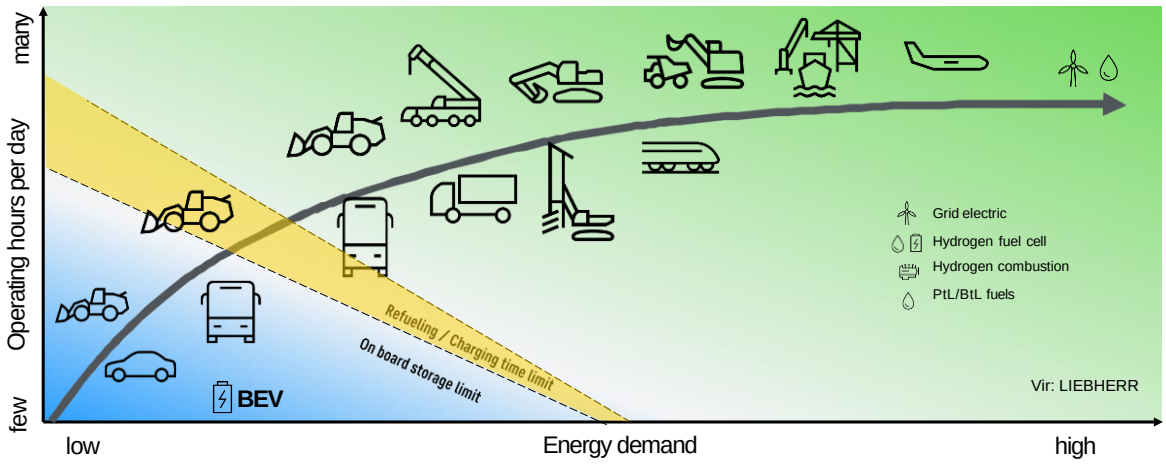
4 Pillar Approach

https://www.cece.eu/stream/april-2021-position-paper-the-role-of-construction-equipment-in-decarbonising-europe

Vir: LIEBHERR

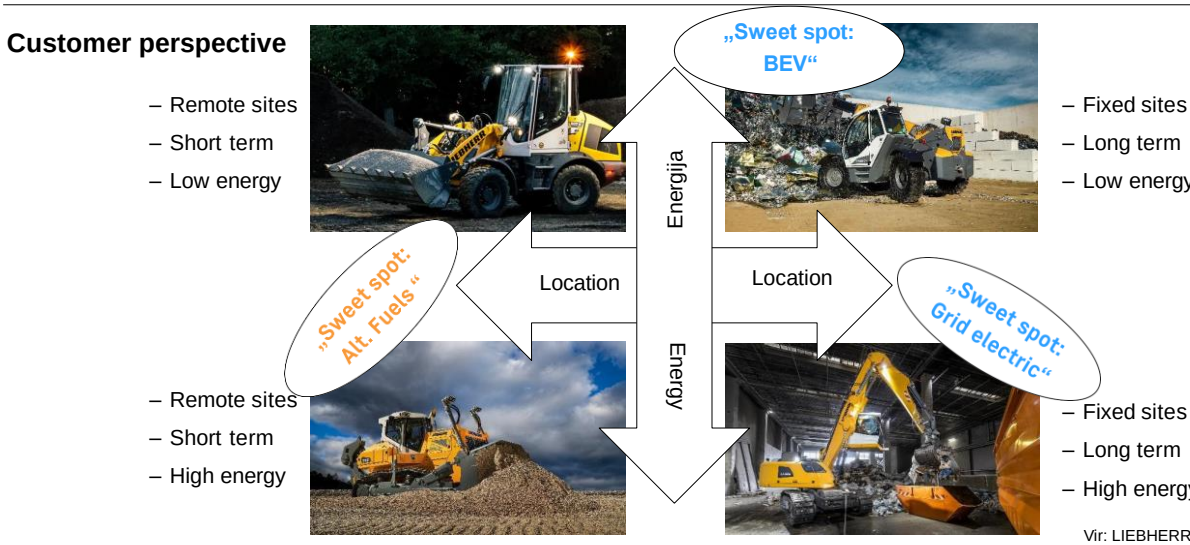
Trajnost z vidika proizvajalca – Liebherr AG

Alternative Energy Source:



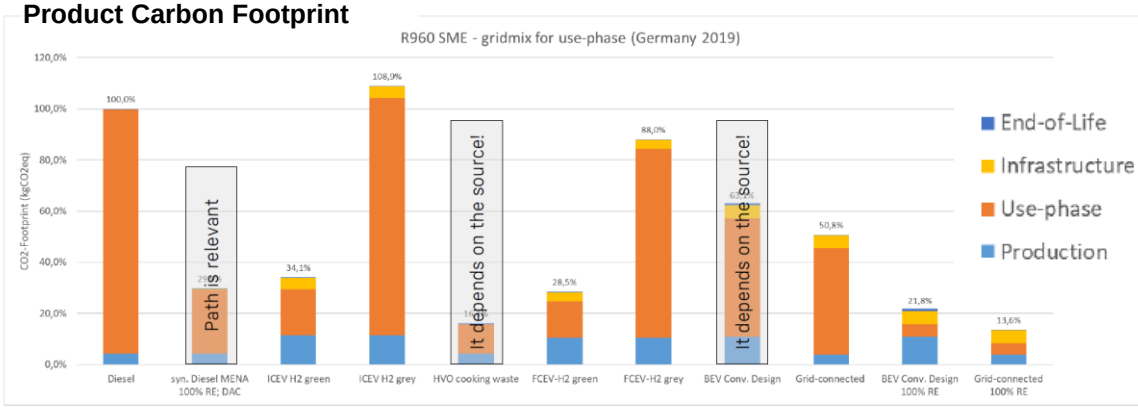
Trajnost z vidika proizvajalca opreme – Liebherr AG

Customer perspective



Trajnost z vidika proizvajalca opreme – Liebherr AG

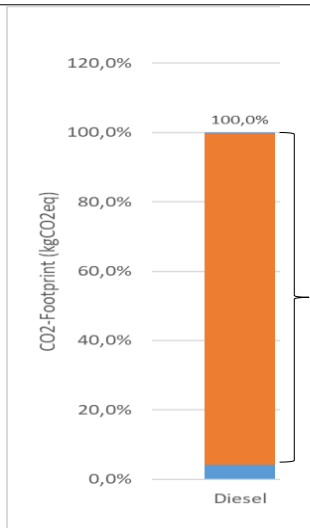
Product Carbon Footprint



- BEV: Batterie Electric Vehicle
- BSZ-H2: Hydrogen Fuel Cell
- HVO: Hydrotreated Vegetable Oil (synthetic fuel)
- Grey: Grey Hydrogen from Natural Gas
- Green: Green Hydrogen from renewable energy
- ICEV H2: Hydrogen Internal Combustion Engine

Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG



Which work is done?

Product Carbon Footprint

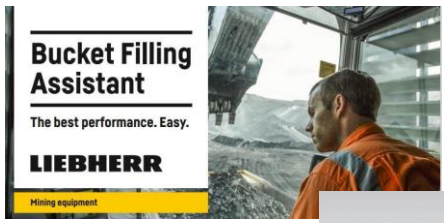
- Is there a clear perspective which work is done within a machines lifetime?
- How we can compare machine A vs. B?
- What is the work:
  - Bring material from A to B?
  - Use Attachment A for time B?
  - Form Shape A from B?

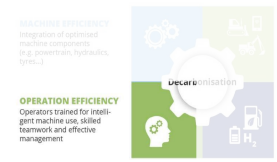
There are many A´s and B´s in this equation!

Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG

Operation efficiency:





– Optimize operating time
– Optimize comfort
– Optimize productivity of driver

Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG

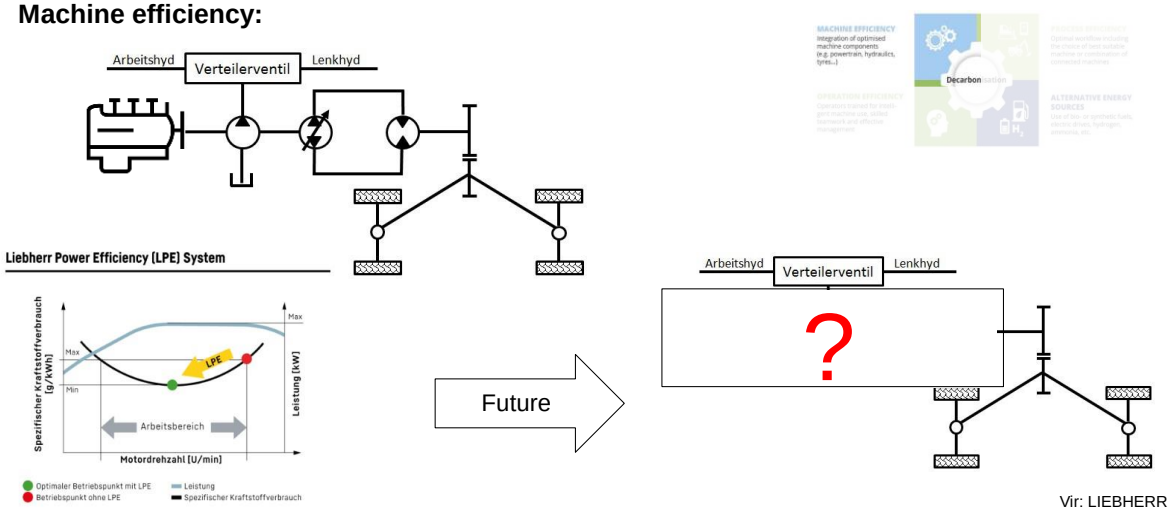
Process efficiency:

– Help customers to optimize their Jobs/Jobsites
– Easy data transparency

Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG

Machine efficiency:



Vir: LIEBHERR

Trajnost z vidika proizvajalca opreme – Liebherr AG

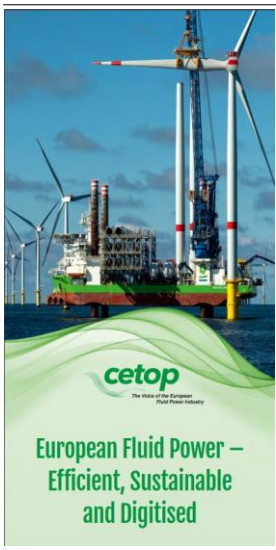
Njihova spoznanja:

- Efficiency is not easy to define
- We will need a clear target from the customer how and what to optimize
- The **overall approach** will lead to the **highest reduction** of carbon emissions
- There should be a clear "**Work done"-Approach** for the different machines and applications to support the customers with the right information

Vir: LIEBHERR

Trajnost z vidika strokovnih združenj: CETOP, NFPA

Trajnost z vidika strokovnega združenja – CETOP



Fluid power – serving our environment

… The challenges placed on us increase not only due to the increased pressure of competition, but increasingly due to the environmental impact and our objective of offering as many people as possible a decent world to live in. …

Future-proof automation and drive systems

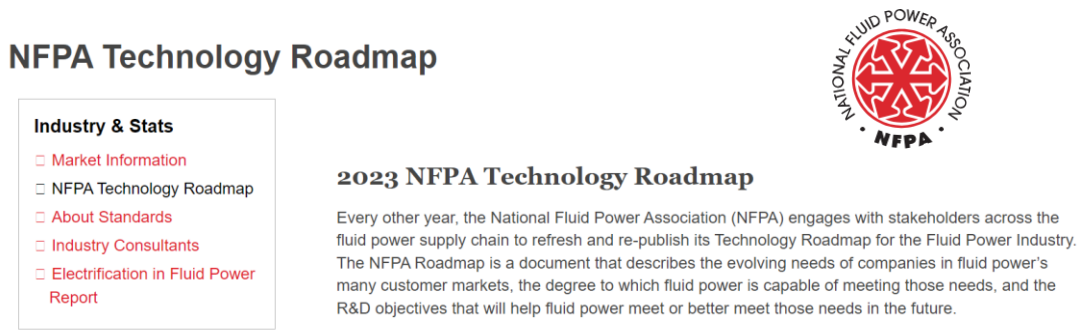
… Fluid power focuses on the integration of functions and the reduction of external interfaces and contributes to energy efficiency. Customers are concentrating more and more on their core competence and therefore require ready-made and tested subsystems instead of individual components. …

Energy and Resource Efficiency – Efficient Fluid Power

… The only currently viable alternative way of reducing energy costs is energy saving, or in other words higher energy efficiency. How can this be achieved most effectively?
It is important to achieve further increases in degrees of efficiency, for example by minimizing frictional and throttling losses, etc. …

Vir: CETOP Op.: lastno dodano

Trajnost z vidika strokovnega združenja – NFPA



Vir: NFPA Op.: lastno dodano

Trajnost z vidika strokovnega združenja -

Electrification is a buzzword throughout most industries now and is a common topic being discussed at conferences, events, and board rooms. While many businesses and industries have already embraced electrification, others are still working to understand the impacts, opportunities, and decision points to make. To add further confusion, electrification means many different things and is a

1. Many markets are experiencing an electrification trend, that is power sources that serve as the prime mover in either the pro Is this a trend in the XXX market?
   A. Yes
   B. No (if no, skip to next section)

2. Please estimate the percent of products in the XXX market tha (either alone or in hybridization with an internal combustion e the propulsion circuit, work circuit, or both.
   A. In 2022:
   B. In 2030:

CUSTOMER MARKETS	N	Is there an electrification trend in this market?
Aerospace Product and Parts Manufacturing	12	75%
Agricultural Machinery	49	71%
Automotive and Light Truck Manufacturing	11	91%
Chemical Processing Machinery	2	100%
Class 4-8 Trucks (including vocational trucks)	8	88%
Construction Machinery	37	89%
Food Processing Equipment	12	100%
Lawn and Garden Equipment	13	100%
Material Handling (including conveying) Equipment	26	92%
Medical Equipment	8	50%
Metalworking Machinery and Machine Tools	15	40%
Mining Machinery	18	78%
Oil and Gas Machinery	9	56%
Packaging Machinery	10	70%
Paper Machinery	6	67%
Plastics and Rubber Machinery	4	75%
Power Generation Equipment	2	50%
Printing Machinery	3	67%
Sawmill and Woodworking Machinery	7	71%
Semiconductor Machinery	6	67%

Yes
91-100%
81-90%
71-80%
61-70%
51-60%
0-50%

Vir: NFPA Op.: lastno dodano

Trajnost z vidika strokovnega združenja – NFPA

Predicted Growth of Electrified Machines

CUSTOMER MARKETS	N	Estimated percent of electrified machines in 2022	Estimated percent of electrified machines in 2030	Increase 2030 vs. 2022
Aerospace Product and Parts Manufacturing	2	53%	55%	3
Agricultural Machinery	24	8%	32%	24
Automotive and Light Truck Manufacturing	8	10%	45%	35
Chemical Processing Machinery	1	20%	60%	40
Class 4-8 Trucks (including vocational trucks)	6	6%	26%	20
Construction Machinery	28	4%	23%	19
Food Processing Equipment	8	58%	79%	21
Lawn and Garden Equipment	11	10%	37%	27
Material Handling (including conveying) Equipment	20	34%	53%	18
Medical Equipment	2	98%	98%	0
Metalworking Machinery and Machine Tools	4	75%	85%	10
Mining Machinery	14	21%	39%	18
Oil and Gas Machinery	4	18%	36%	19
Packaging Machinery	4	65%	84%	19
Paper Machinery	4	70%	81%	11
Plastics and Rubber Machinery	2	45%	53%	8
Power Generation Equipment	1	90%	95%	5
Printing Machinery	2	63%	73%	10
Sawmill and Woodworking Machinery	5	53%	75%	22
Semiconductor Machinery	2	55%	88%	33

% electrified
81-100
61-80
41-60
21-40
1-20
0

Increase % points
31-40
21-30
11-20
1-10
0

Vir: NFPA Op.: lastno dodano

Trajnost z vidika strokovnega združenja – NFPA

Predicted Impacts on Fluid Power Products

It is likely that the increases in electrified machines in the markets described above will have the following general effects on fluid power system strategies and the demand for specific fluid power components.
In this environment, observers should see:

System strategies

MORE DEMAND FOR:
- Controls
- Hydraulic heating
- Thermal management
- Integrated devices (EHAs, etc.)
- Decentralized systems
- Noise reduction
- Higher connectivity to sensors and data, likely driven by demand from customers for higher value (predictive maintenance, optimized and efficient control, etc.)
- Variable speed electric motors driving smaller fixed displacement pumps

LESS DEMAND FOR:
- Hydraulic cooling

Trajnost z vidika strokovnega združenja – NFPA

Components

MORE DEMAND FOR:
- Thermal valves
- Smaller, higher-pressure pumps (able to handle higher input speeds from electric motors)
- Use of new thermally-capable, variable viscosity fluids
- Accumulators
- Sensors, controllers, IoT products

LESS DEMAND FOR:
- Valves (in general)
- Variable volume pumps
- Use of traditional hydraulic oil
- Small actuators/cylinders
- Small and medium duty motors (especially traction and fan motors)
- Hoses and fittings

NO DRAMATIC CHANGE IN DEMAND FOR:
- Actuators/Cylinders (in general)

Trajnost z vidika strokovnega združenja – NFPA

Technology Frontiers

Successfully adapting fluid power systems for electrified mobile equipment will require some technology growth and development - a task that many in the fluid power industry are already working on and finding success with. As the electrification trend progresses to larger machines with longer duty cycles, several strategies will be key.

1. Hybridized Devices
2. Energy Balance
3. Wireless Sensors
4. Thermal Management
5. Impact of Newer Fluids

2.0 Rešitve za večjo trajnost 14-IFK

- Energetsko učinkoviti pretvorniki energije
- Materiali in izboljšanje učinkovitosti komponent fluidne tehnike
- Hidravlične tekočine za večjo trajnost
- Primeri s področja mobilne hidravlike
- Trajnost na področju pnevmatike
- Uporaba simulacij za namene povečanja energetske učinkovitosti komponent
- Arhitektura sistemov in koncepti vodenja za povečanje trajnosti fluidne tehnike
- Aplikacije za bolj zeleno prihodnost

Rešitve za večjo trajnost – učinkovitost komponent in sistemov

THERMAL ANALYSIS OF THE CYLINDER BLOCK OF AN AXIAL PISTON PUMP – THE KEY TO MONITORING EFFICIENCY

Roman Ivantysyn*, Jürgen Weber, Alexander Kunze, Wieland Uffrecht

Institute of Mechatronic Engineering, Technische Universität Dresden, Helmholtzstrasse 7a, 01069 Dresden

The primary objective of this paper is to demonstrate the existence of a direct correlation between a pump's efficiency, characterized by its losses, and its temperature. To illustrate this relationship, the focus was set on the temperature field of the cylinder block of a 160cc open circuit pump.

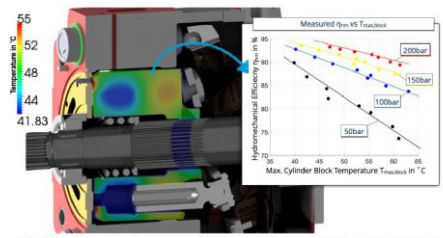


Figure 1: 160cc pump rotating kit, expected temperature field and measured hydromechanic efficiency trend with maximum cylinder block temperature.

The ability to predict efficiency using steady-state surface tem combined with the block temperature's rapid response to the p operational changes, lends credence to the notion that this met for real-time condition monitoring in axial piston pumps. Mor be achieved without compromising the block's durability or th integrity of the pump. With a wireless sensor can be effortless the surface without necessitating any wired connections. Both data transfers are executed wirelessly through a straightforwar located inside the pump housing.

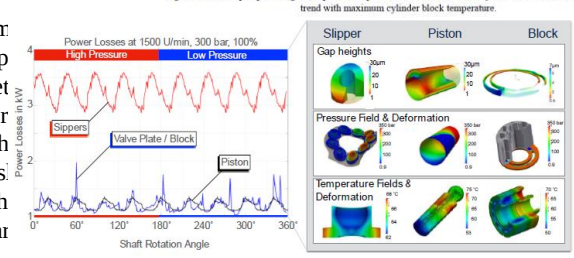


Figure 6: Outputs of the simulation including individual power losses.

Rešitve za večjo trajnost – učinkovitost komponent in sistemov

COMPARISON STUDY OF FULLY INDIVIDUALIZED SYSTEM ARCHITECTURES FOR ELECTRIFIED MINI-EXCAVATORS: DISPLACEMENT CONTROL (DC) VS ELECTRO-HYDRAULIC ACTUATION (EHA)

Timir Patel[1]*, Leonardo dos Santos Franquilino[1], Andrea Vacca[1], Charlie Your

[1]*Maha Fluid Power Research Center, Purdue University, Lafayette, IN 47905, USA*
[2] *Bobcat Company, Bismarck, ND 58504, USA*

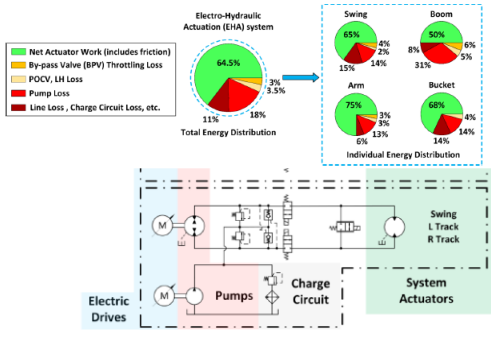


Figure 3: Hydraulic Circuit of Fully Individualized Electro-Hydraulic Actuated (EHA) Excavator

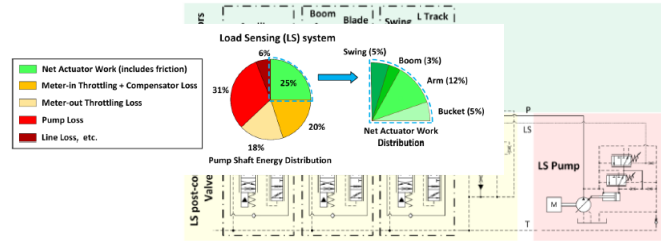


Figure 1: Simplified Hydraulic Circuit of Reference Excavator

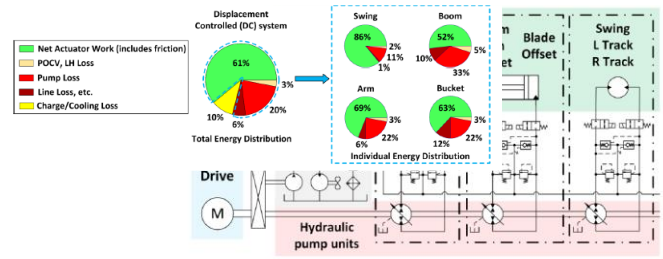


Figure 2: Hydraulic Circuit of Fully Individualized Displacement Controlled (DC) Excavator

Rešitve za večjo trajnost – učinkovitost komponent in sistemov

RUN-IN BEHAVIOUR AND WEAR ON HYDRAULIC PISTON SEALS – EVALUATION OF AN ENDURANCE TEST FOR PISTON ACCUMULATORS

Tobias Schulze*[,1], Vladimir Boyko[1], Michael Lenz[1], Gonzalo Barillas[2], Mert van Dawen[2], Ejnar Jørgensen[3], Erik Garde[4]

[1] *TUD Dresden University of Technology, Chair of Fluid-Mechatronic Systems (Fluidtronic), Helmholtzstrasse 7a, 01069 Dresden, Germany*
[2] *Freudenberg Sealing Technologies GmbH, Ascheröder Strasse 57, 34613 Schwalmstadt, Germany*
[3] *Lind Jensens Maskinfabrik A/S, Krogmusvej 7, 6940 Lem, Denmark*
[4] *Vestas Wind Systems A/S, Hedeager 42, 8200*

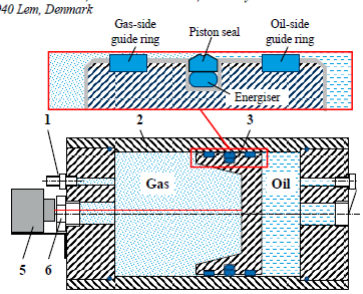


Figure 1: Schematic structure of the investigated piston accumulator

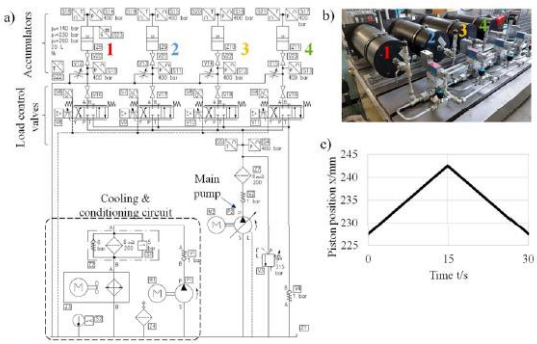


Figure 2: a) Hydraulic circuit of the test rig; b) Photo of the test rig; c) Piston target position

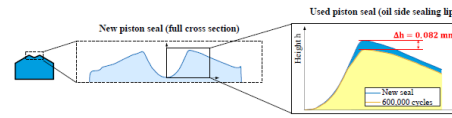


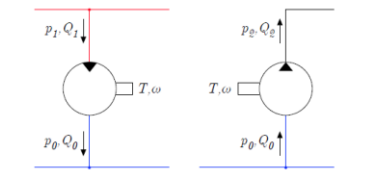
Figure 8: Cross section of the sealing lips and evaluated groove depth

Rešitve za večjo trajnost – učinkovitost komponent in sistemov

EFFICENCY DEFINITIONS OF HYDRAULIC TRANSFORMERS AND FIRST TEST RESULTS OF THE FLOATING CUP TRANSFORMER (FCT80)

Robin Mommer*, Sef Achten, Jeroen Potma, Jasper Achten, Peter Achten

INNAS B.V., Nikkelstraat 15, 4823AE Breda, The Netherlands



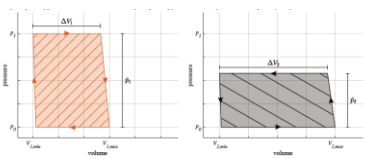
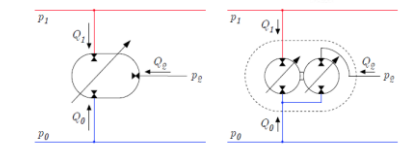


Figure 3: Ideal *pV*-diagram of a single piston in case of a motor (a) and a pump (b). The arrows show



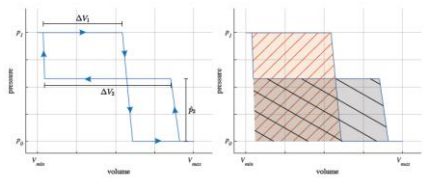


Figure 4: Ideal *pV*-diagram of a single piston in a transformer that uses the IHT principle.

The transformer combines the functions of pump and a motor in one design. Therefore the transformer port plate has three ports instead of two. One is connected to the high pressure line. This kidney delivers the power when a load requires flow with a certain pressure. A second kidney is connected to the load. The third is connected to the low pressure line.

Rešitve za večjo trajnost – učinkovitost komponent in sistemov

REMAINING USEFUL LIFE ESTIMATION FOR RUBBER O-RING UNDER STORAGE CONDITIONS CONSIDERING DEPENDENT PERFORMANCE INDICATORS

Rentong Chen[1], Shaoping Wang[1], Chao Zhang[1,2*], Boyu Shen[1], Zhouhe Xie[1]

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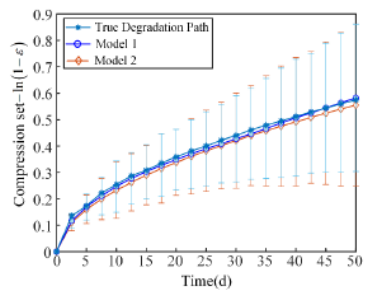
[2]*Research Institute of Frontier Science, Beihang University, Beijing, 100191, P.R. China*

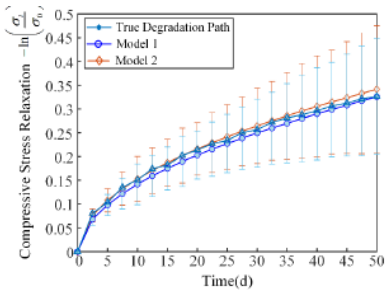
* Corresponding author: Tel.: +86 10 82338365; E-mail address: cz@buaa.edu.cn

Initial values for unknown parameters $\Theta=(\mu_{\eta 1},\sigma_{\eta 1}^2,\lambda_1,\gamma_1,\mu_{\eta 2},\sigma_{\eta 2}^2,\lambda_2,\gamma_2,\theta)$ are determined by the off-line degradation data. The reliability model based on bivariate dependent performance indicators is given by:

$$\Delta X_k(t_{ij})=X_k(t_{i,j+1})-X_k(t_{ij})$$
$$\Delta X_k(t_{ij})\sim IG\left(\eta_k\Delta t_{ij},\lambda_k(\Delta\Delta t_{ij})^2\right),\frac{1}{\eta_k}\sim N\left(\mu_{\eta k},\frac{1}{\sigma_{\eta k}^2}\right)$$
$$f\left(\Delta X_1(t_{ij}),\Delta X_2(t_{ij})\right)=\prod_{k=1}^{2}\prod_{i=1}^{N}\prod_{j=1}^{M_i}f_k\left(\Delta X_k(t_{ij});\Theta_k^{IG}\right)\prod_{i=1}^{N}\prod_{j=1}^{M_i}c\left(F_1(\Delta X_k(t_{ij})),F_2(\Delta X_k(t_{ij}));\theta\right) \quad (17)$$
$$(k=1,2;i=1,2,\cdots,N;j=1,2,\cdots,M_i)$$

Figure 1: The degradation test rig.





Rešitve za večjo trajnost – hidravlične tekočine

HOLISTIC EFFICIENCY MEASUREMENTS OF A MOBILE WORKING MACHINE: COMPARISON OF CONVENTIONAL MINERAL OILS AND A SUSTAINABLE WATER-BASED FLUID

Sebastian Deuster[1]*, Katharina Schmitz[1]

[1]*RWTH Aachen University – Institute for Fluid Power Drives and Systems (ifas)*
* Corresponding author: Tel.: +49 241 80-47740; E-mail address: sebastian.deuster@ifas.rwth-aachen.de

Section	Process
1	Digging movement 0 - 25 sec
2	Rotation upper carriage 25 - 32 sec
3	Unload movement 32 - 44 sec
4	Rotation to starting position 44 sec - end

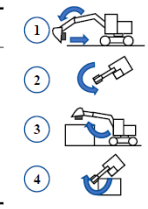


Figure 2: Dig and dump cycle

Table 2: Important properties tested hydraulic fluids [20, 21, 30, 31]

Hydraulic fluid	Viscosity class [32]	Viscosity index [33]	Density [g/cm³] (20 °C)	Specific heat capacity [kJ/(kg K)]	Thermal conductivity [W/(m K)]	Pressure Viscosity Coefficient [(GPa)$^{-1}$] (25 °C)
HLP	46	113	0.86	1.9–2.2	0.13–0.14	20.0
HVLP	32	195	0.85	1.9–2.2	0.13–0.14	20.0
HFC	46	206	1.08	3.3	0.3–0.43	2.0

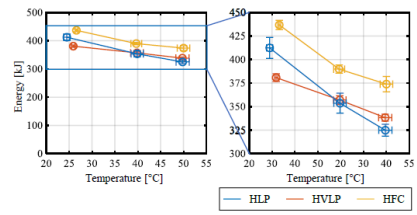


Figure 6: Energy consumption dig and dump cycle

Rešitve za večjo trajnost – materiali in tribologija

ON POLYOXYMETHYLENE COMPOSITE FOR SUSTAINABLE HYDRAULIC VALVES

Ana Trajkovski[1]*, Nejc Novak[1], Mitjan Kalin[1], Franc Majdič[1]

[1]*Laboratory for Fluid Power and Control, Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva cesta 6, 1000 Ljubljana, Slovenia*

Table 1: Lubricants properties

Lubricant	Kin. Viscosity at 25 °C [mm²/s]	Kin. Viscosity at 80 °C [mm²/s]	Density at 25 °C [g/cm³]	Density at 80 °C [g/cm³]
ISO VG46	100	9	0.86	0.86
G+W	11.59	2.19	1.17	1.12
W	0.89	0.36	0.99	0.97

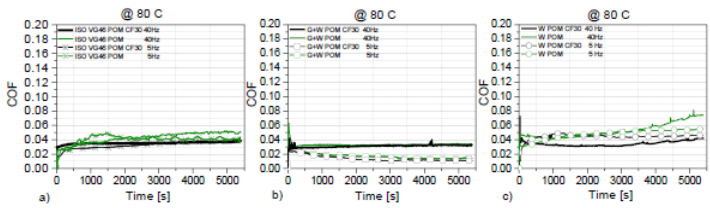


Figure 4: Coefficient of friction evolution during the tribological test of POM CF30 and POM in three different lubricants: a) ISO VG46; b) Glycerol + Water; c) Water all at 80 °C

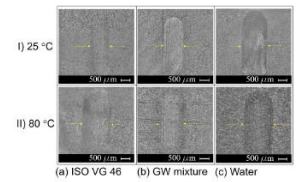


Figure 8: Digital images of worn POM CF30 polymer surfaces at (I) room and (II) elevated temperature, lubricated with: (a) Oil ISO VG46; (b) Glycerol-water mixture; (c) Water all at 5 Hz

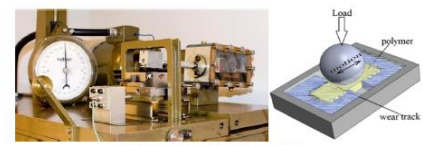


Figure 1: Scheme of tribological tests

Rešitve za večjo trajnost – hidravlični sistemi

METHODOLOGY OF SYSTEM PARAMETER OPTIMIZATION FOR PARALLEL ELECTRIC HYDRAULIC HYBRID MOBILE MACHINE VIA CONVEX PROGRAMMING

Zichang Lin[1], Jiaming Wu[1], Zhenchuan Lin[1], Feng Wang[1]*, Bing Xu[1]

[1] State Key Laboratory of Fluid Power Components and Mechatronic Systems, School of Mechanical Engineering, Zhejiang University, 866 Yuhangtang Road, 310030, Hangzhou, China.

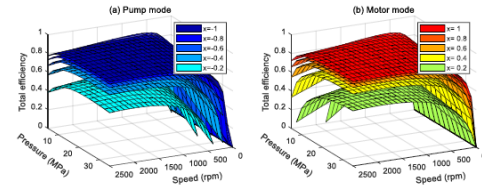


Figure 5: Fitted HM efficiency map with different displacement fraction. (a) pump mode. (b) motor mode

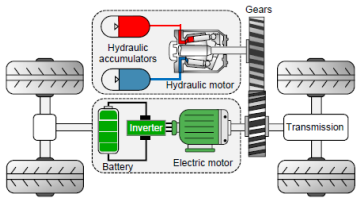


Figure 1: PEHH wheel loader schematic

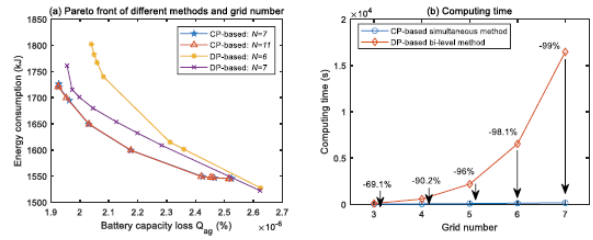


Figure 10: Comparison between CP-based simultaneous method and DP-based bi-level method (a) Pareto optimal solutions (b) Computing time.

Rešitve za večjo trajnost – hidravlični sistemi

OPTIMAL SPEED TRAJECTORY OF ELECTRIC WHEEL LOADERS AIMING AT EXTENDING BATTERY LIFETIME

Haoxiang Zhang[1], Qi Zhang[1], Jiajia Wang[1], Yihan Qiao[1], Feng Wang[1]*, Bing Xu[1]

[1]School of Mechanical Engineering, Zhejiang University, 866 Yuhangtang Road, Hangzhou, Zhejiang 310027, P. R. China
* Corresponding author: E-mail address: dieter@zju.edu.cn

Figure 1: Powertrain of the electric wheel loader

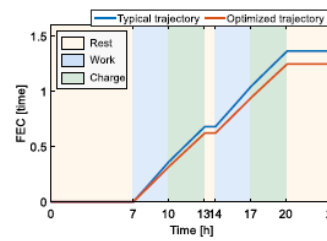


Figure 3: Accumulated FEC in one-day work under the typical and optimized trajectories

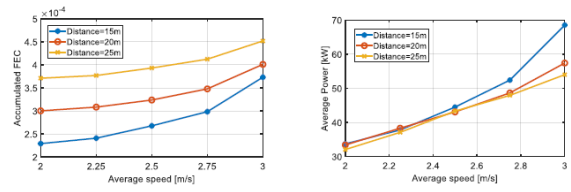


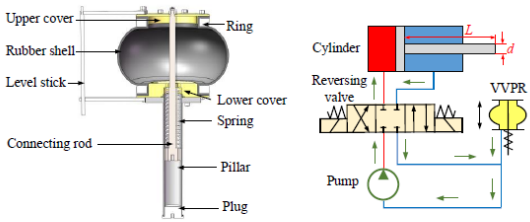
Figure 7: Accumulated FEC and average power of the optimal trajectory at different average speeds

Rešitve za večjo trajnost – hidravlični sistemi

COMPARATIVE ANALYSIS OF PERFORMANCES OF NON-METAL PRESSURIZED RESERVOIRS WITH VARIABLE VOLUME

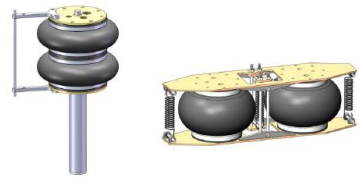
Jing Yao[1,3], Dingyu Wang[1,3]*, Dong Liang[1,3], Jinlu Hao[1,3], Pei Wang[2,3]

[1] *State Key Laboratory of Crane Technology, Yanshan University, West of Hebei Avenue 438, 066004 Qinhuangdao, China*



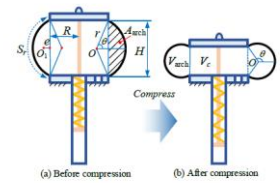
(a) Structure of the single-layer reservoir (b) Application in the system

Figure 1: Working principle diagram of the VVPR



(a) Series reservoir (b) Parallel reservoir

Figure 2: The configuration iteration of VVPR



(a) Before compression (b) After compression

Figure 3: Compression deformation of the rubber shell of VVPR

Table 1: Parameters of three configurations

Parameter	Single-layer reservoir	Series reservoir	Parallel reservoir
Structural volume [l]	1	2	2
Variable volume [l]	0.8	1.6	0.8
Pressure [bar]	0.2-0.51	0.15-0.65	0.15-0.62
Total weight of VVPR [kg]	6.3	7.2	13.9
Radius of upper cover [mm]	68	68	68

Rešitve za večjo trajnost – hidravlični sistemi

COMPARISON OF STRATEGIES FOR UNNOTICEABLE MODE SHIFTING IN MOBILE INDEPENDENT METERING SYSTEMS

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[1]*Institute of Mechatronic Engineering, Technische Universität Dresden, Helmholtzstrasse 7a, 01069 Dresden*
[2] *Hydac Fluidtechnik GmbH, Industriegebiet D-66280 Sulzbach/Saar*

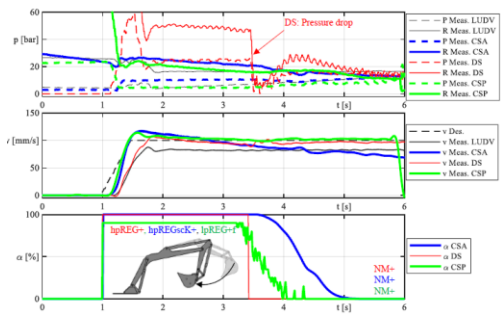

Figure 8: Comparison of shifting strategies CSA, CSP and DS.

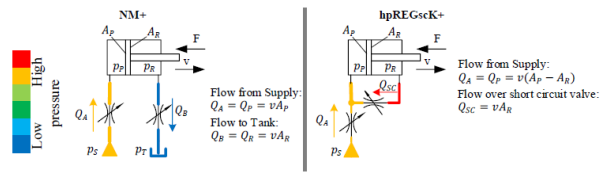

Figure 1: Normal extension NM+ (left) and high-pressure-regeneration hpREGscK+ (right). The thickness of the lines indicates the volume flow, the colour the pressure level.

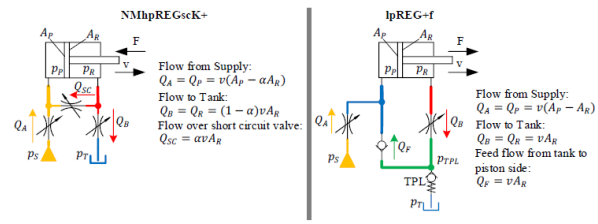

Figure 2: Extension in continuously variable mode normal extension to high-pressure short circuit regeneration NMhpREGscK+ (left) and in low-pressure regeneration lpREG+f (right), requiring active load and a pressurized tank line.

Rešitve za večjo trajnost – pnevmatika

FEASIBILITY STUDY AND EXPERIMENTAL VALIDATION OF A NOVEL COMBINED THROTTLING APPROACH

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[1]Institute for Fluid Power Drives and Systems (ifas),RWTH Aachen University, Campus-Boulevard 30, D-52074 Aachen, Germany

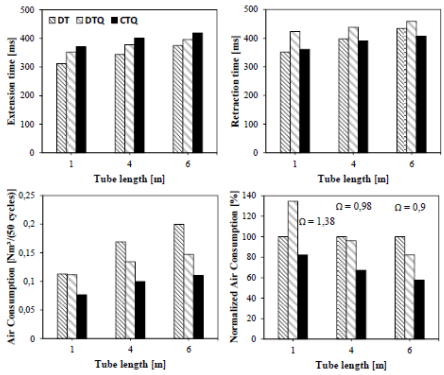

Figure 10: Measured results for Ø 32 x 200 with M = 10 kg

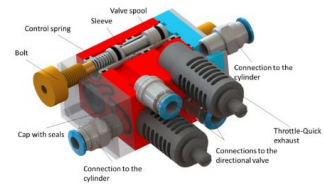

Figure 3: Mechanical design of the novel switching scheme

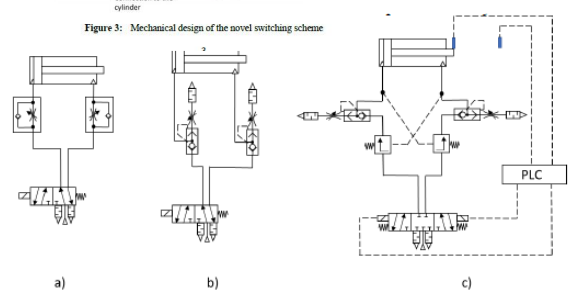

Figure 2: Investigated Systems: a) downstream throttling (DT), b) downstream throttling with quick exhaust (DTQ) and c) adaptive upstream throttling with quick exhaust (CTQ).

Rešitve za večjo trajnost – pnevmatika v stregi

A TRAJECTORY-SPECIFIC APPROACH FOR CALCULATING THE REQUIRED HOLDING FORCE FOR SURFACE GRIPPERS

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[1] Graduate School of Excellence advanced Manufacturing Engineering (GSaME), University of Stuttgart, Nobelstraße 12, 70569 Stuttgart, Germany

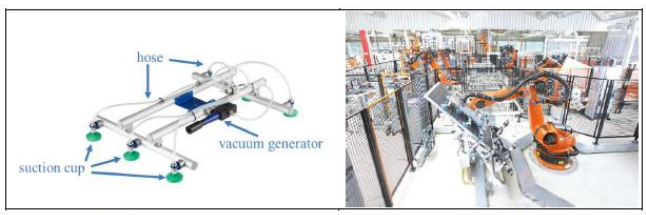


Figure 1: Typical structure of a vacuum handling system and a typical industrial application [7]

The first approach extends the current state of the art to include additional intermediate positions for the gripping object and the gripper. The second approach extends the first approach and takes the spatial expansion of the gripping object into account too

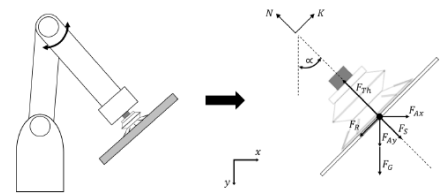


Figure 3: Mechanical modeling for thin gripping objects

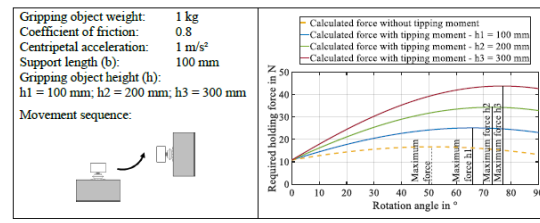


Figure 7: Theoretically required holding force when swivelling gripping objects with relevant thickness

Rešitve za večjo trajnost – elektrificirani sistemi

SOLUTIONS FOR ENERGY-EFFICIENT AND EASY IMPLEMENTABLE ELECTRIFIED VARIABLE-SPEED PUMP DRIVES IN MOBILE APPLICATIONS

Dr. Steffen Rose[1]*, Dominik Hoffmann[1], Fabian Wiedmer[1], Viktor Rill[2]

[1]*Bosch Rexroth AG, Lise-Meitner-Strasse 2, 89081 Ulm, Germany*

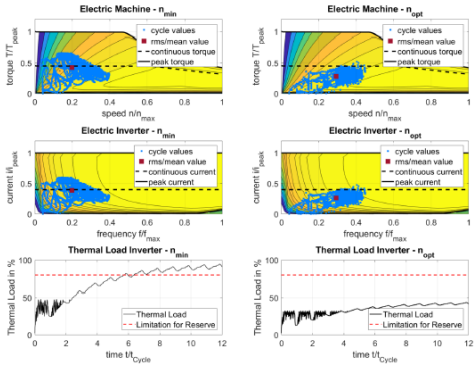
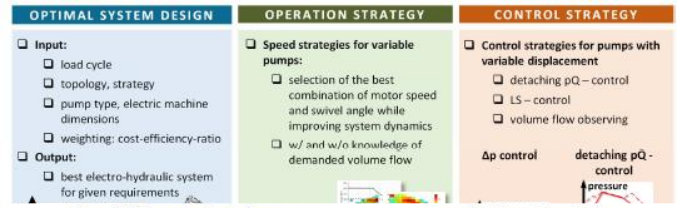


Figure 8: Effects of the speed strategies on the thermal behaviour of the drive components



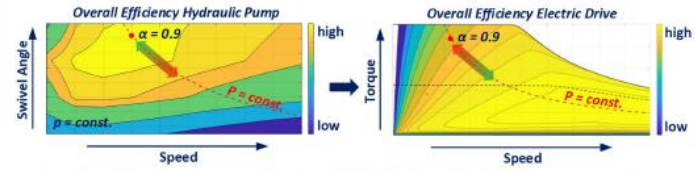


Figure 4: Exemplary efficiency maps of the hydraulic pump (left) and the electric drive (right)

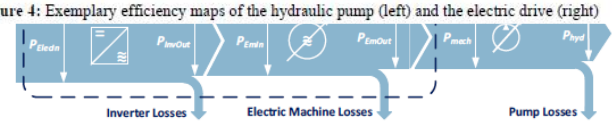


Figure 3: Schematic representation of the power flow within the electrified pump system

Rešitve za večjo trajnost – H_2, HFC

HYDROGEN POWERED HYDRAULIC POWERPACK

Dipl.-Ing. Lukas Trommler[1]*, Dipl.-Ing. Frank Hänel[1], Prof. Dr.-Ing. Frank Will[1]

[1]*Institute of Mechatronic Engineering, Technische Universität Dresden, Helmholtzstrasse 7a, 01069 Dresden*

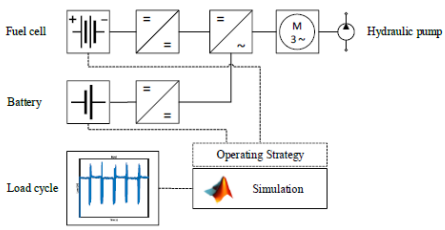


Figure 6: Block diagram of the hydraulic powerpack

Table 3: Comparison of energy distribution in an ICE and a fuel cell [9]

	ICE [%]	Example ICE [kW]	Fuel cell [%]	Example FC [kW]
Mechanical/ electrical work	30	10	50	10
Cooling	25	8,3	40	8
Exhaust gas enthalpy	35	11,7	10	2
Friction	10	3,3	-	-
Total	100	33,3	100	20

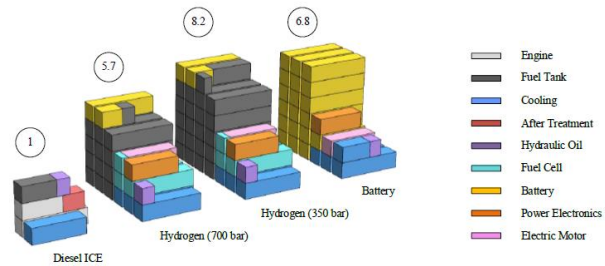
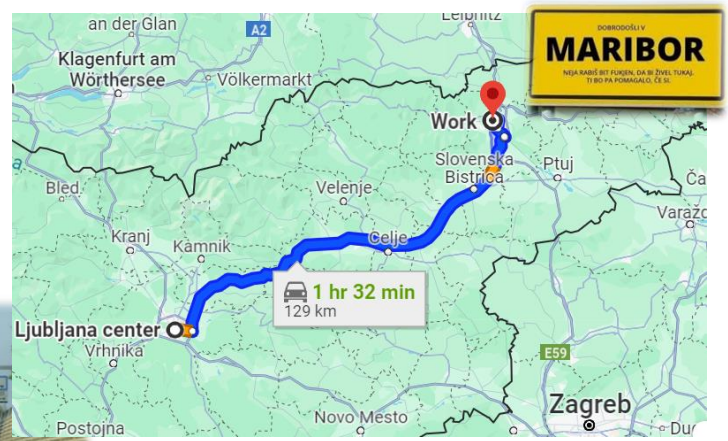


Figure 7: Comparison of installation space for ICE, H_2 350 bar, H_2 700 bar and battery technology

3.0 Prihodnost fluidne tehnike

3. Kako dalje? Naslednji koraki
4. Prispevek slovenskih raziskovalcev k povečanju energetske učinkovitosti in trajnosti
5. Videnje problematike slovenskih uporabnikov: mnenja-pripombe…
6. Zaključna misel – kaj nas čaka v bližnji prihodnosti?

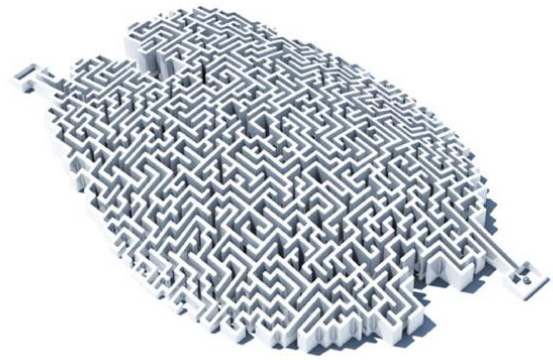
Pot do cilja



Rešitve za večjo trajnost – inovacije

innovation

- labyrint as a metaphor
- no maps
- no Google
- many dead ends and pitfalls
- high risk
- almost impossible yet unavoidable

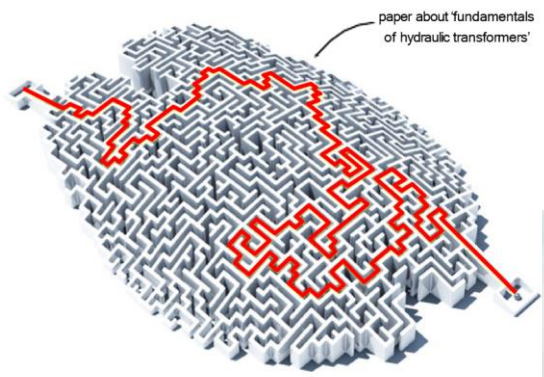


In kako poročati o inovacijah, spoznanjih, dosežkih? Ali s svojim uspehom s tem ne usmerjamo tudi konkurence?

Rešitve za večjo trajnost – pot in ovire; primer razvoja novega hidravličnega transformatorja

guiding you through the maze

- positive displacement
- pressure amplification
- no minimum speed limitations...
- ...even at high pressure loads
- dynamic and stable variable control
- high maximum speed
- 2 quadrants
- high efficiency
- low noise



Prihodnost fluidne tehnike

risk management

- ranljivosti
- grožnje
- tveganja

Prihodnost fluidne tehnike

risk management

- ranljivosti
- grožnje
- tveganja

Prihodnost fluidne tehnike

risk management

- ranljivosti
- grožnje
- tveganja

Prihodnost fluidne tehnike

Industrija fluidne tehnike

- ranljivosti
- grožnje
- tveganja

- predraga
- zelo neučinkovita
- konkurenca iz Kitajske
- konkurenčnost novih sistemov in komponent
- zmanjšan promet in dobičkonosnost
- lahko konča v stečaju

Prihodnost fluidne tehnike (skozi oči proizvajalca INNAS Technologies)

(samo) Dva velika izziva

increased competition,
especially from China

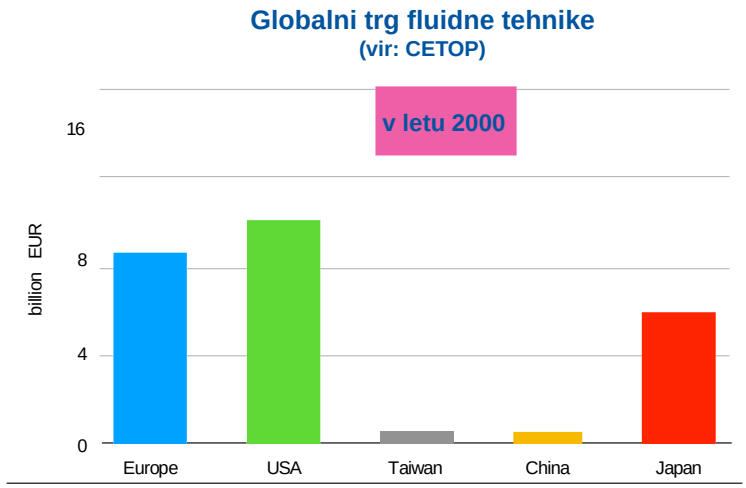
fundamental change of demands, especially about sustainability

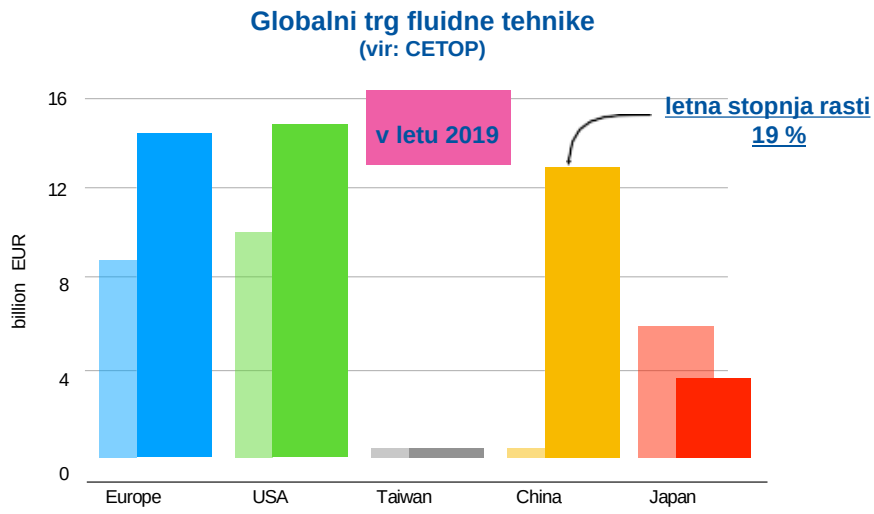
Prihodnost fluidne tehnike

(samo) Dva velika izziva

increased competition,
especially from China

Prihodnost fluidne tehnike





Prihodnost fluidne tehnike

Kitajska ekspanzija

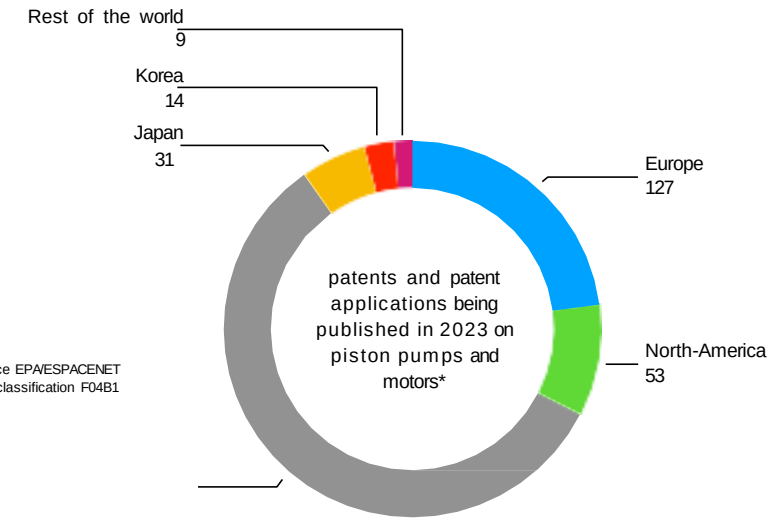
Sichuan Changjiang Hydraulic Parts Co. Ltd.

Linde Hydraulics (Weichai Power)

Jiangsu Hengli Hydraulic Technology Co., Ltd.

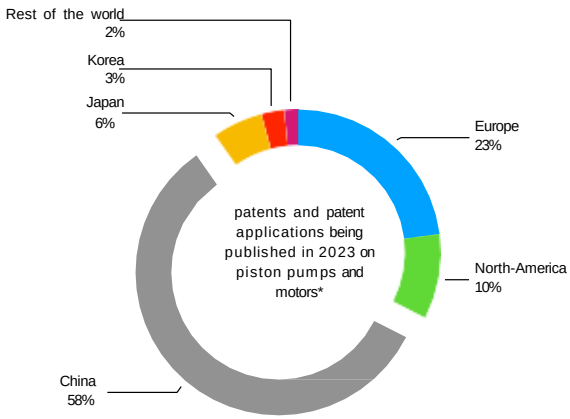
Prihodnost fluidne tehnike

Ne le izdelano, temveč tudi zasnovano na Kitajskem! (?)

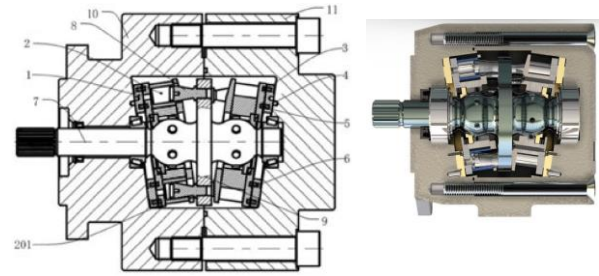


*source EPA/ESPACENET
IPC-classification F04B1

Prihodnost fluidne tehnike



Ne le izdelano, temveč tudi zasnovano/patentirano na Kitajskem! (?)



Sipag Nantong

Spag Nantong vs. INNAS

Prihodnost fluidne tehnike

Ne le izdelano, temveč tudi zasnovano?/patentirano na Kitajskem in predstavljeno kot Kitajski dosežek !!!

Hengli vs. INNAS

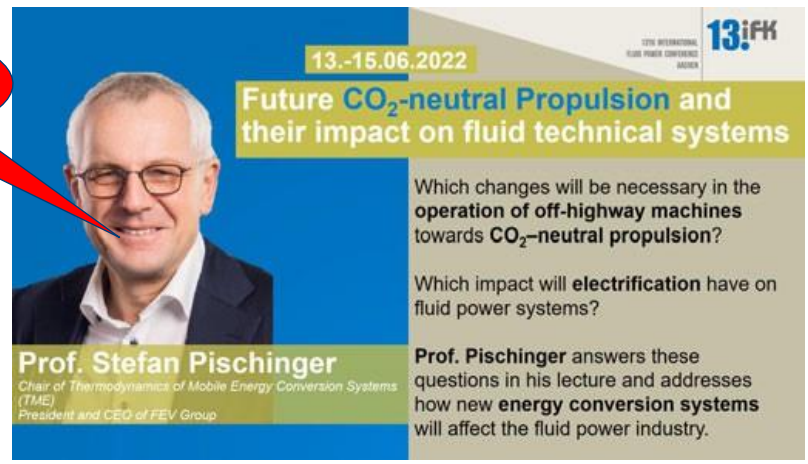
Prihodnost fluidne tehnike

(samo) Dve veliki spremembi

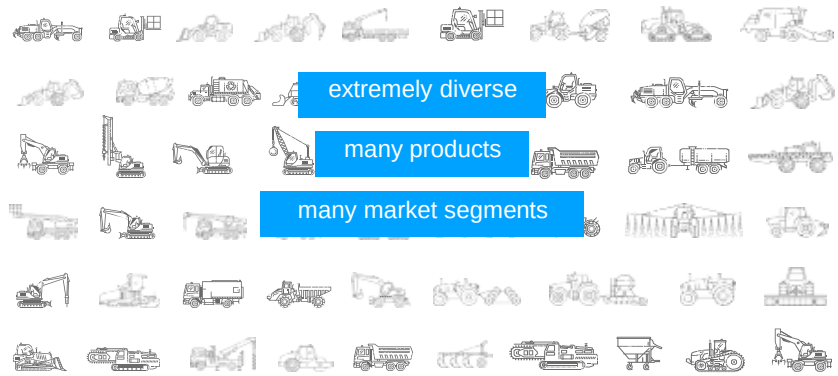
fundamental change of demands, especially about sustainability

Prihodnost fluidne tehnike

"Fluid power will become a niche market"



Prihodnost fluidne tehnike



Prihodnost fluidne tehnike

trg mobilne mehanizacije

- Productivity is key
- Machines often work in remote locations
- Machines work many hours per day
- Machines work in harsh environments

Prihodnost fluidne tehnike

Trg mobilne mehanizacije

Popolna elektrifikacija (z baterijami ali gorivnimi celicami) je zelo malo verjetna

Motor z notranjim zgorevanjem bo najverjetneje ostal tudi v naslednjih desetletjih pri veliki večini mobilnih strojev

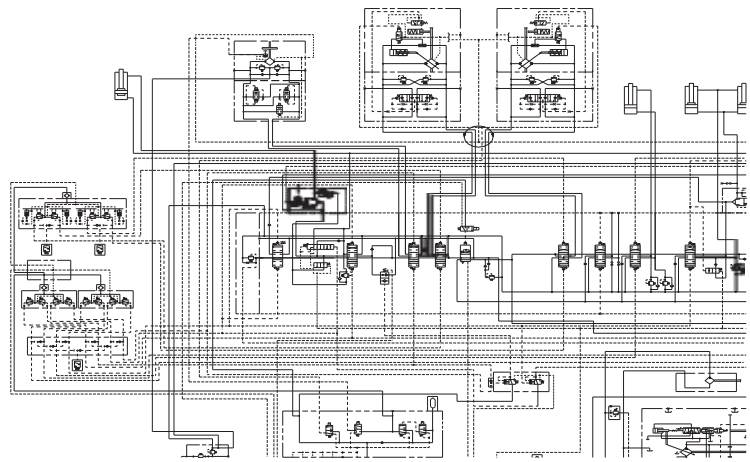
Preklop na (veliko dražja) trajnostna goriva

Slaba energetska učinkovitost hidravličnih sistemov ni več sprejemljiva

Prihodnost fluidne tehnike

Kaj si želi industrija?

- a new standard system for hydraulic systems is needed
  - replacing current LS- and negative flow control systems
  - needs to be (much) more efficient
  - needs to have equal or better productivity
- higher componentcosts are accepted (to a certain degree)



Prihodnost fluidne tehnike

Kaj si želi industrija?

committed to climate targets in 2030
sciencebasedtargets.com

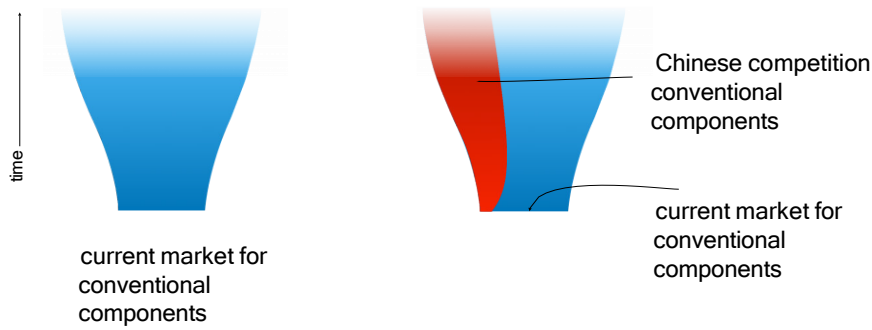
in 2030 the GHG-emissions need to be reduced by 50% compared to 2019

Robert Bosch
Danfoss
Parker Hannifin

John Deere, Komatsu, Volvo CE,
Sandvik, Hitachi, CNH,
Hyundai, Kawasaki, Atlas Copco

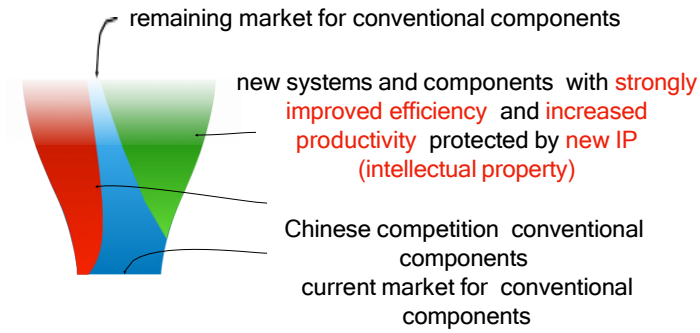
Prihodnost fluidne tehnike

fluid power threats and risks



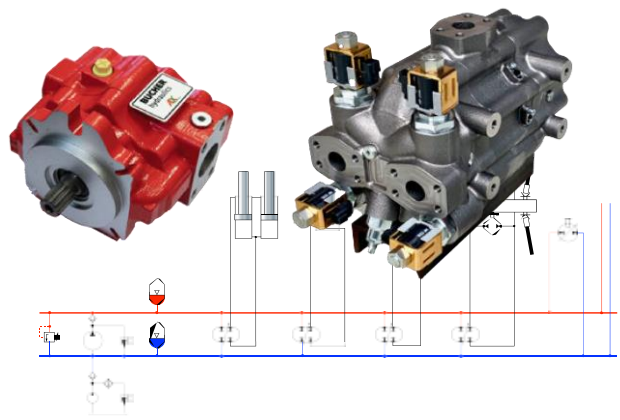
Prihodnost fluidne tehnike

fluid power threats and risks



Prihodnost fluidne tehnike

new products entering the market



Prihodnost fluidne tehnike

Naš prispevek k trajnosti

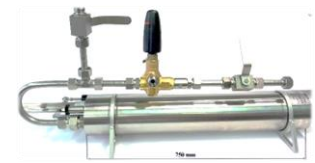
LASIM FS UL

LFT FS UL

LaOH FS UM

Naš prispevek k trajnosti – LFT FS UL

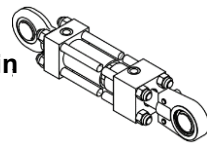
Univerza v Ljubljani
Fakulteta za strojništvo



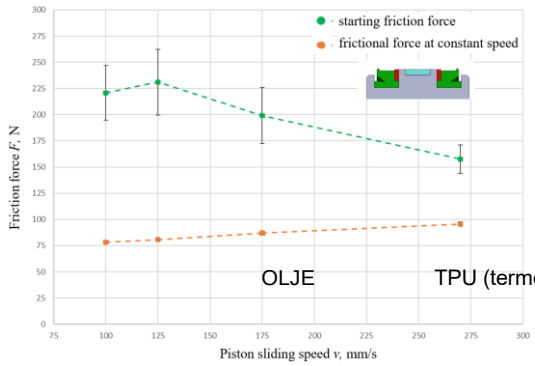
- Proporcionalni 4/3 potni ventil,
- Batni hidravlični akumulator,
- Konvencionalni drsniški 4/3 potni ventil,
- Topološko optimirano ohišje 3d natisnjenega 4/3 potnega v
- Gerotor hidravlični motor,
- Hidravlični cilinder s skoznjo batnico,
- Protipovratni ventil,
- Batna črpalka,
- Vodno-hidravlični agregat …

Naš prispevek k trajnosti – LFT FS UL

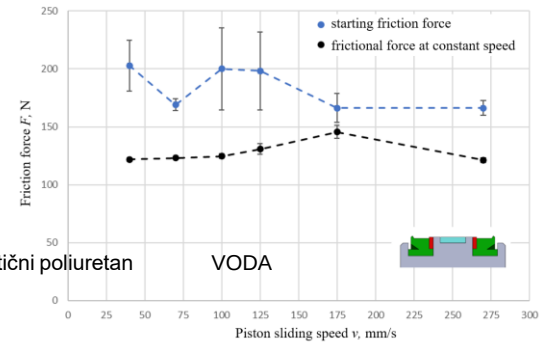
Tribološke lastnosti tesnil hidravličnih cilindrov v vodni in oljni hidravliki



Sila trenja batnih tesnil različnih materialov v olju (mineralno hidravlično ISO VG 46) in v vodi



OLJE



TPU (termoplastični poliuretan

VODA

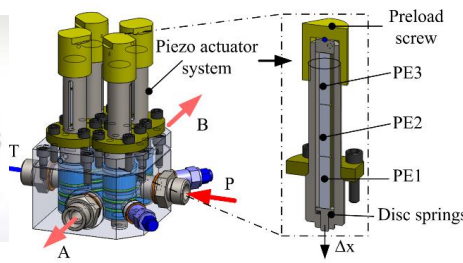
Naš prispevek k trajnosti – LASIM FS UL

LASIM
LABORATORIJ ZA STREGO, MONTAŽO IN PNEVMATIKO

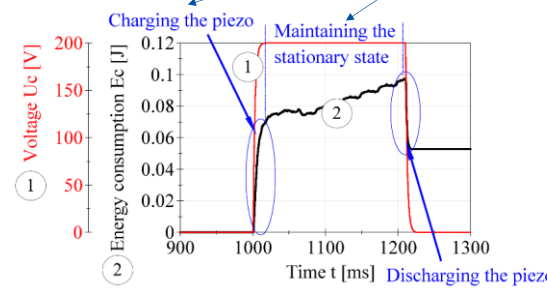
Univerza v Ljubljani
Fakulteta za strojništvo

Energijsko učinkoviti hidravlični piezo ventili

- Piezo aktuatorji za hidravlične preklopne ventile
- Poraba energije v stacionarnem (aktivnem delu) minimalna – mnogo manjša od običajnih elektromagnetnih ventilov



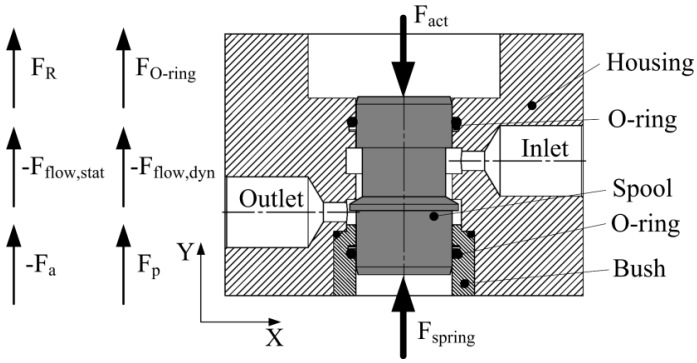
$$E\,[J] = n \cdot \left(E_{switch}\,[J] + \left(T_{period}\,[s] \cdot W_{hold}\,[J/s]\right)\right)$$

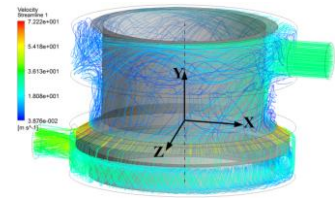


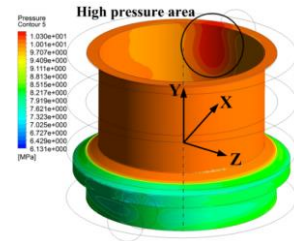
Vir: UL FS LASIM, 4-potni hidravlični ventil sestavljen iz 4 preklopnih piezo ventilov

Naš prispevek k trajnosti – LASIM FS UL

- Zmanjšanje tokovnih sil v ventilu pomeni manjše potrebne moči za preklope – elektromagneti manjših moči za enake nazivne velikosti ventilov.



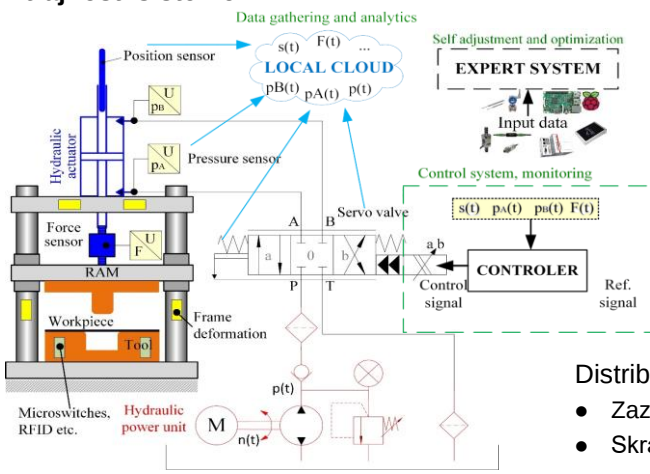


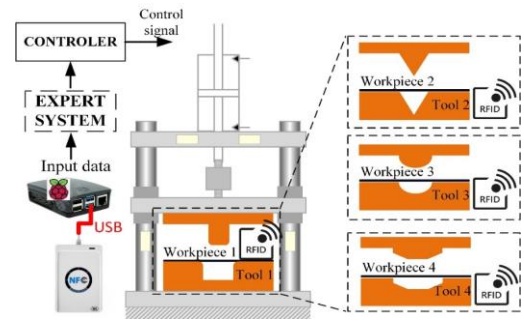


Geometrijske lastnosti vhodne in izhodne komore hidravličnih ventilov močno vplivajo na smer tokovnic in posledično na tlačne razmere in tokovne sile na površine glavnega krmilnega bata ventila – zmanjšanje aksialne sile za faktor 4, možnost uporabe aktuatorjev manjših moči za prekrmiljenje ventila.

Naš prispevek k trajnosti – LASIM FS UL

Napredne hidravlične stiskalnice za povečanje učinkovitosti procesov in s tem trajnosti sistemov





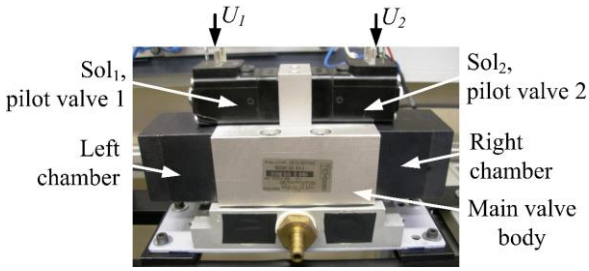
Distribuirani inteligentni sistemi

- Zaznavanje orodja
- Skrajšanje časov menjav in priprave orodij

Naš prispevek k trajnosti – LASIM FS UL

Napredni pnevmatični ventili in batki z izboljšanimi lastnostmi

- Uporaba kompozitnih materialov
- Višja dinamika ventilov
- Bolj stabilno krmiljenje
- Zmanjšana obraba krmilnih batov s trdimi prevlekami
- Podaljšani življenjski cikli ventilov
- Zmanjšana perioda vzdrževanja

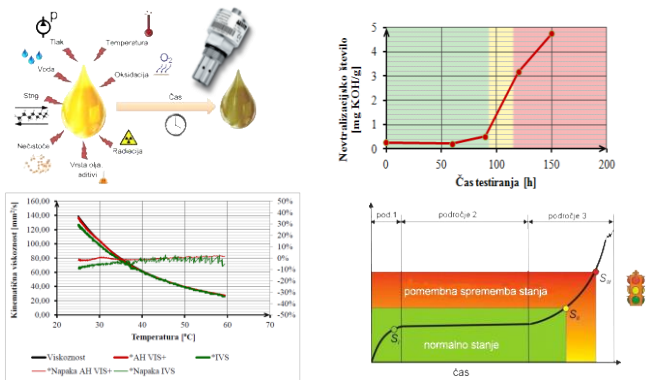


Naš prispevek k trajnosti – LaOH FS UM

LaOH
Univerza v Mariboru

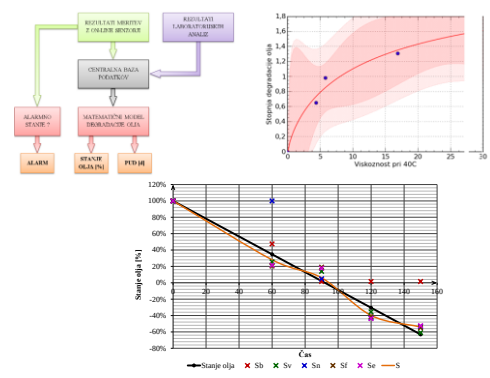
Hidravlične tekočine

On-line nadzor stanja - OCM



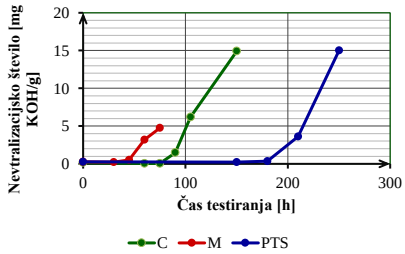
Napoved preostale uporabne dobe - RUL

$$S = S_{i1} \cdot 0{,}5 + S_{i2} \cdot 0{,}25 + S_{i3} \cdot 0{,}125 + S_{i4} \cdot 0{,}0625 + S_{i5} \cdot 0{,}0625$$

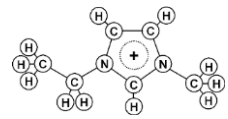


Naš prispevek k trajnosti – LaOH FS UM

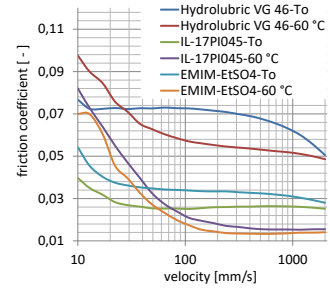
Primerjalno testiranje vzdržljivosti olja



Ionske hidravlične tekočine - HIL



EMIM-EtSO$_4$
1-Ethyl-3-methylimidazolium ethylsulfate



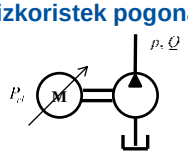
Prednosti:

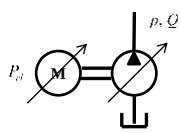
- ❖ dobre mazalne lastnosti
- ❖ nevnetljive
- ❖ okolju prijazne
- ❖ skoraj ničelni parni tlak
- ❖ termično stabilne
- ❖ nastavljiva viskoznost
- ❖ zelo visok indeks VI
- ❖ tekoče do -60 ºC
- ❖ zelo široko temperaturno delovno območje
- ❖ združljive z materiali v hidravliki
- ❖ brez prilagoditev pri zamenjavi za olje…

Naš prispevek k trajnosti – LaOH FS UM

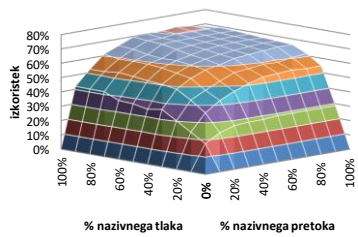
Učinkovitost hidravličnih pogonskih sistemov

Hitrostno regulirane konstantne in nastavljive črpalke – eta koncept vodenja pogona (glede na najvišji izkoristek pogona



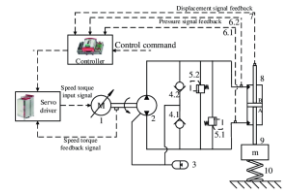


Robustna in dovolj dinamična izvedba prilagajanja pretoka potrebam porabnika, brez dušenja, tudi v load- sensing izvedbi



Hidravlične osi direktno gnane s hitrostno regulirano črpako

Požarno varna zasnova v lahki izvedbi servo valj direktno reguliran s črpalko, kompakten dizajn izoliran od okolja, z uporabo HIL



Prihodnost fluidne tehnike

Kaj nas čaka jutri?

Prihodnost fluidne tehnike

Fluidna tehnika jutri






Hidravlika postaja vse bolj zelena

Fluidna tehnika jutri

Steve Atchison
Project Engineering Manager/RFQ Coordinator

March 26, 2024

- **Electrically Controlled Hydraulics:**
- **Energy Efficiency and Sustainability:**
- **Digitalization and IoT Integration:**
- **Intelligent and Adaptive Controls:**
- **Miniaturization and Lightweight Solutions:**
- **Hydraulic Hybrid Systems:**
- **Advanced Materials and Lubricants:**
- **Safety and Predictive Maintenance:**

Conclusion:
Innovations in hydraulic technology continue to shape the future of various industries. Electrically controlled hydraulics, energy efficiency, digitalization, intelligent controls, miniaturization, hydraulic hybrids, advanced materials, and safety enhancements are among the notable trends driving this evolution. As the industry progresses, hydraulic systems will become more precise, connected, and sustainable, offering enhanced performance, efficiency, and reliability. Embracing these innovations will unlock new possibilities and open doors to a future where hydraulic technology plays a crucial role in powering our world. With ongoing research and development, the potential for further advancements in hydraulic technology is vast, promising exciting prospects for the industry and the multitude of applications it serves.

Fluidna tehnika jutri

Six Challenges for the Fluid Power Industry

1. **Increasing energy efficiency**
2. **Improving reliability**
3. **Building smart components and systems**
4. **Reducing size and weight**
5. **Reducing environmental impact**
6. **Improving and applying energy storage and redeployment capabilities**

Vir: NFPA Website December 2009
www.nfpa.com/ourindustry/technology_roadmap.asp

Six Challenges for the Fluid Power Industry

1. **Reducing environmental impact**
2. **Increasing energy efficiency**
3. **Reducing size and weight**
4. **Building smart components and systems**
5. **Improving reliability**
6. **Improving and applying energy storage and redeployment capabilities**

Prioritete: maj 2024

Should a hard-working engineer worry about trends in hydraulic motion control, especially in challenging economic times?

Smart engineers know that there is always more to learn from others who are facing similar challenges.

Hvala za udeležbo, in da ste mi prisluhnili!

Kontakt

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Univerza v Mariboru

darko.lovrec@um.si