1. ABSTRACT

Sustainable development and resource efficiency are the common global strategies of the 21st century. The actual global natural resource consumption of humankind went far over the limit and to cover this worldwide resource consumption the productivity of 1.5 earths is now necessary.

The work *"Reduction of anthropogenic environmental influences by advanced and optimized technologies"* discussed the problem of advanced resource efficiencies with mining activities in South Africa as an example. Related strategies to reverse anthropogenic impacts to such an extent that it resembles former natural conditions were also discussed. Heavy metal contaminated soil and water were treated with natural techniques and different natural media to reduce and eliminate contamination and to provide a market value for former unusable material. Specially developed soil ameliorants and natural filter media could increase the total quality of soil and water. Even plants could be established in these changed conditions. Applied to the natural environment an overall upgrade of mining activities could be achieved.

To optimize these laboratory and field results support was generated by using evolutionary algorithms as part of the artificial intelligence. By combining applied technologies with the evolution strategy an optimization tool could be developed to simulate, optimize and forecast procedures of anthropogenic impact reversion. With this tool a transfer of solutions to other similar applications in under-developed and developing countries could be shown.

The trans-disciplinary scientific approach of balancing the trigger element carbon proved that the reduction to the smallest common element carbon can be used to balance processes and to indicate pollution. As stated in the United Nations Framework, carbon balances are one of the most significant causes of environmental problems, including environmental pollution and health and are also closely related to climate change in general. With carbon balances resource efficiency and resource protection can be transferred into practice.

Finally, all results were collected and verified in a decision support system with the aim to optimize the treatment steps and to make the results transparent and available for users in academia and practice. The work was exemplary in showing that the approach of environmental sciences and techniques to reverse anthropogenic interferences back to natural sustainability and evolution, optimized the equilibrium of nature.

2. OPSOMMING

Volhoubare ontwikkeling en effektiwiteit van hulpbronne is die algemene globale strategieë van die 21ste eeu. Die werklike globale verbruik van natuurlike hulpbronne deur die mensdom het die limiet vêr oorskry en om hierdie wêreldwye hulpbronverbruik te kan dek is die produktiwiteit van 1.5 aardes nou nodig.

Die werk *"Reduction of anthropogenic environmental influences by advanced and optimized technologies"* bespreek die problem van gevorderde hulpbron-effektiwiteit met mynbou-aktiwiteite in Suid-Afrika as 'n voorbeeld. Verwante strategieë om antropogeniese impakte om te keer tot so 'n mate dat dit die natuurlike kondisies verteenwoordig wat voorheen bestaan het, word ook bespreek. Grond en water wat gekontamineer is met swaarmetale is met natuurlike tegnieke en verskillende natuurlike media behandel om die kontaminasie te verminder of te elimineer asook om 'n markwaarde te voorsien aan voorheen onbruikbare materiaal. Grondbehandelingsprodukte en natuurlike filter media wat spesiaal ontwikkel is kan die totale kwaliteit van grond en water verhoog. Selfs plante kan in hierdie veranderde kondisies gevestig word. Wanneer dit in die natuurlike omgewing aangewend word, kan 'n opgradering van mynbou-aktiwtiteite bereik word.

Om hierdie laboratorium- en veldresultate te optimiseer, is ondersteuning gegenereer deur die gebruik van evolusionêre algoritmes as deel van die kunsmatige intelligensie. Deur toegepaste tegnologieë met die evolusionêre strategie te kombineer, kon 'n optimiseringshulpmiddel ontwikkel word om die prosedures vir die omkeer van antropogeniese impakte te simuleer, optimiseer en voorspel. Met hierdie hulpmiddel kon 'n oordrag van oplossings na ander soortgelyke toepassings in onderontwikkelde en ontwikkelende lande aangedui word.

Die transdissiplinêre wetenskaplike benadering wat gevolg is deur die balansering van die sneller-element koolstof, het bewys dat die vermindering van die kleinste gemeenskaplike element, koolstof, aangewend kan word om prosesse te balanseer en besoedeling aan te dui. Soos in die United Nations Framework gestel word, is koolstofbalanse een van mees beduidende oorsake van omgewingsprobleme, insluitend omgewingsbesoedeling en gesondheid en dit is ook nou verwant aan klimaatsverandering in die algemeeen. Met koolstofbalanse, kan hulpbron-effektiwiteit en –beskerming oorgedra word na die praktyk.

Ten slotte, alle resultate is versamel en geverifiëer in 'n besluitnemingsondersteuningstelsel wat daarop gemik is om die behandelingstappe te optimiseer en om die resultate deursigtig en beskikbaar te maak vir die akademie en die praktyk. Die werk is 'n uitstekende voorbeeld om te wys dat die benadering van omgewingswetenskappe en -tegnieke gebruik kan word om antropogeniese impakte om te keer na natuurlike volhoubaarheid en evolusie en daardeur die ekwilibrium van die natuur te optimiseer.