REVIEW OF OPTIMIZATION OF TURBINE DISTRIBUTOR SYSTEM

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ABSTRACT:

Many literature Review has been carried out in the development of Pelton turbine. It has been observed that hydro power generation is of great importance. The efficiency of Pelton Turbine in effected by improving the material characteristics of the distributor. Design optimization has been persued in the light of smarter materials in the light of smarter materials and capital cost saving.A material selection procedure has been obtained, thereby formulating the problem as 'Optimization of turbine distributor using less thickness material selection'.

1. INTRODUCTION:

There are so many turbines available in the literature, however here we only focused on optimization of pelton wheel turbine. The pelton wheel turbine is an impulse turbine which is very easy to understand. In this A nozzle transforms water under a high head into a powerful jet. The momentum of this jet is destroyed by striking the runner, which absorbs the resulting force. If the velocity of the water leaving the runner is nearly zero, all of the kinetic energy of the jet has been transformed into mechanical energy, so the efficiency is high. A practical impulse turbine was invented by Lester A. Pelton in California around 1870. There were high-pressure jets there used in placer mining, and a primitive turbine called the hurdy-gurdy, a mere rotating platform with vanes, had been used since the '60's, driven by such jets. Pelton also invented the split bucket, now universally used. Pelton is a trade name for the products of the company he originated, but the term is now used generically for all similar impulse turbines.

The Pelton wheel is a water impulse turbine. It was invented by Lester Allan Pelton in the 1870s. The Pelton wheel extracts energy from the impulse of moving water, as opposed to its weight like traditional overshot water wheel. Although many variations of impulse turbines existed prior to Pelton's design, they were less efficient than Pelton's design; the water leaving these wheels typically still had high speed, and carried away much of the energy. Pelton's paddle geometry was designed so that when the rim runs at ½ the speed of the water jet, the water leaves the wheel with very little speed, extracting almost all of its energy, and allowing for a very efficient turbine.

There are two types of turbines, reaction and the impulse, the difference being the manner of head conversion. In the reaction turbine, the fluid fills the blade passages, and the head change or pressure drop occurs within the runner. An impulse turbine first converts the water head through a nozzle into a high-velocity jet, which then strikes the buckets at one position as they pass by. The runner passages are not fully filled, and the jet flow past the buckets is essentially at constant pressure. Impulse turbines are ideally suited for high head and relatively low power. The Pelton turbine used in this experiment is an impulse turbine.

2.LITERATURE REVIEW:

Alnaga A. et al. [3] stated that the development of an automatic iterative procedure for optimal design of hydraulic turbine distributors. This procedure based on the geometry parameterization of the distributor to facilitate the fully automatic generation of the design by modifying the geometry parameters, and Evolutionary Algorithms to define the best design parameters using optimal functions (regrouped fixed objectives) evaluated from CFD results to decide the design quality

Anagnostopoulos J. S.and Papantonis D. E. [4] stated that an alternative numerical methodology is developed for a fast and effective simulation and analysis of the complex flow and energy conversion in Pelton impulse hydro turbines. The algorithm is based on the Lagrangian approach and the unsteady free-surface flow during the jet-bucket interaction is simulated by tracking the trajectories of representative fluid particles at very low computer cost.

Atthanayake I.U. [5] It was assumed that the effect from of above all the losses were negligible when deriving the Mathematical formula governing the performance of the Pelton wheels. And also it was assumed that the all the water escapes from the bucket with the same velocity. Among the various analytical studies that had been done on Pelton turbine hydraulics less attention has been paid to the friction along the buckets. In this paper the effect of bucket friction was analyzed using Boundary Layer theory.

B.S. Mann [6] stated that Boronizing of steels has been very effectively used in overcoming adhesive, sliding and abrasive wear. However, little information is available on boronized cast chromium–nickel steel (13Cr–4Ni) with regard to cavitation-erosion and abrasion resistance as well as their effect on mechanical properties. In this paper, the cavitation-erosion characteristics along with abrasive wear of boronized 13Cr–4Ni steel are studied in detail. Cavitation-erosion resistance was evaluated by using a rotating disc apparatus, whereas abrasive wear was studied as per ASTMG-65. These phenomena are being correlated with mechanical properties such as resilience and strain-energy. Drastic reduction in elongation and strain-energy of borided steel has resulted in poor cavitation-erosion resistance whereas improvement of the order of 300% was observed in abrasive wear resistance.

Baltasar Penate B. and Rodriguez L.G. [7] stated that the reduction of SEC (specific energy consumption) is the field with the most specific technical research focus and effort in SWRO (seawater reverse osmosis) plants. For existing installations with energy recovery systems consisting in Pelton turbines, the most significant challenge is how to reduce energy costs. The highest efficient isobaric ERD (energy recovery devices) are used in order to produce major savings in energy consumption in the desalination process and/or to increase the freshwater capacity of the installations, by taking full advantage of the plant equipment. This paper gives a brief overview of the technology used to recover the energy from brine stream in large desalination plants, with a description of the modifications required if the recovery system with Pelton turbines is to be replaced by systems based on isobaric-chamber devices. All possibilities analysed are deeply justified technically and thermo economically within an exhaustive assessment.

Cateni A. et al. [8] stated that Hydraulic efficiency plays a relevant role on the performance of Hydro Power Plants (HPP) and constitutes one of the main elements for selecting the most appropriated interventions both of ordinary and extraordinary maintenance as well as for the choice of the consequent amount of investment. Objective of this article is to give an overview on the actual approach to this theme in Italy. The article describes the main methods of intervention for optimizing the HPP performance, such as:

- Partial renewal with complete replacement of obsolete active parts;
- Rehabilitation of deteriorated profiles with different techniques, according to type and cause of deterioration.

Cobb B.R.and Sharp K.V. [9] stated that Pico-hydropower is a viable technology that can be integrated into a decentralized, off-grid approach to rural electrification in regions that currently have only limited access to electricity. The Turgo turbine is classified as an impulse turbine, similar to the Pelton wheel, often used in Pico-hydro systems. Both offer high efficiency for a broad range of site conditions, but the primary difference is that the Turgo can handle significantly higher water flow rates, allowing for efficient operation in lower head ranges and thus potentially expanding the geographic viability. Published data on Turgo operating performance are limited; despite the differences, discussion thereof in design manuals is generally lumped in with the discussion of Pelton wheels. In this study, a laboratory-scale test fixture was constructed to test the operating performance characteristics of impulse turbines. Tests were carried out to determine the effect on turbine efficiency of variations in speed ratio and jet misalignment on two Turgo turbines. The results were compared to similar tests in the same fixture on a Pelton turbine. Under the best conditions, the Turgo turbine efficiency was observed to be over 80% at a speed ratio of approximately 0.46, which is quite good for pico-hydro-scale turbines. Peak efficiencies for both the Pelton and the Turgo turbines occurred at lower than theoretical ideal speed ratios based on a momentum balance; the reduction in speed ratio at which peak efficiency occurs is likely caused by inefficiencies in the turbine. Tests of jet misalignment showed that moving the jet to the inside or outside edge of the turbine blades caused a drop in Turgo efficiency of 10-20% and reduced the optimal speed ratio by 0.03 (6.5%). Radial misalignment had a significant adverse impact on both Turgo and Pelton turbines, however, angular misalignment of the jet is more of a concern for the Turgo turbine. The results stress the importance of proper system design and installation, and increase the knowledge base regarding Turgo turbine performance that can lead to better practical implementation in pico-hydro systems.

Humbeeck J.V. [10] stated that the diversity of (potential) applications using shape memory alloys (SMA), apart from the medical field, becomes quite large. Classic categories such as free recovery, actuators, constrained recovery, pseudo-elasticity or damping require further specifications. For example, micro-actuators, smart materials or active damping, can be all classified as actuator applications, but each of those items demands specific functional performance, dimensions and processing. Furthermore, success for applications can only be realised in so far those materials offer also a price-competitive advantage relative to other functional materials or mechanical designs. This competition requires perfect control of the material performance. It is known that especially Ni–Ti alloys can be tuned relatively easy to some specific requirements of the envisaged application: hysteresis, transformation temperatures, damping capacity. At the other side little is known on recovery stresses, wear resistance, fracture mechanics, fatigue. In this paper has put stress on the 4P-relation: principles–properties–processing–products as well in companies as in universities or other research laboratories. This has been illustrated by describing some actual applications indicating why they are successful, other applications why they failed and still others that can only be realised if some further, probably possible, material improvement can be realised.

Mann B.S. and Arya V. [11] stated that the abrasion and silt erosion characteristics of plasma nitriding and HVOF coatings along with commonly used steels in hydro turbines. For silt erosion characterization, hydrofoils scaled down to 1/10 of the actual hydro turbine blade were selected. Angles of incidence, velocity and Reynolds numbers were maintained similar to those that commonly occur in hydro turbines, simulating low as well as high-energy impingement wear. The abrasive wear characterization was carried out as per ASTM G-65. HVOF coated steel performed much better than plasma nitrided 12Cr and 13Cr–4Ni steels. Plasma nitrided 12Cr steel performed better than plasma nitride 13Cr–4Ni steel. This is due to its higher micro hardness and its ability to absorb more nitrogen under identical plasma nitriding experimental conditions.

Montanari R. [12] stated that an original method for finding the most economically advantageous choice for the installation of micro hydroelectric plants. More precisely, the paper that follows is to be considered in a context defined as "problematic" by those who have the job of constructing water-flow plants with only small head and modest flow rates. With these initial data one can see immediately that the specific energy of the fluid is low and it is therefore necessary to elaborate large masses of water in order to obtain work, and therefore a return, to render such an investment profitable.

Ogayar B. et al. [13] stated that the concerns associated with fossil fuels and energy demands it is appropriate to investigate the large number of abandoned small hydropower plants. In order to solve the difficulty implied, by a viability study on the refurbishment of a small hydropower plant, a series of simple equations has been developed based on the economic optimization of the different elements.

Paish O. [14] stated that Hydropower, large and small, remains by far the most important of the "renewables" for electrical power production worldwide, providing 19% of the planet's electricity. Small-scale hydro is in most cases "run-of-river", with no dam or water storage, and is one of the most cost-effective and environmentally benign energy technologies to be considered both for rural electrification in less developed countries and further hydro developments in Europe.

Penate B. and Rodriguez L. G. [15] stated that Water resources available in the island of Lanzarote, the furthest east of the Canary Islands Archipelago, come mostly from sea water desalination. Desalted water demand in the island has grown considerably in the last decade forcing managers to adapt desalinated water supply constantly. Additionally, the energy dependence of the water cycle in the island is relevant, so any corrective measures over the water supplies will be welcome if it gets more resource with the lowest energy cost.

Pereza F.J. et al. [16] stated that the influence of implanted Si, Mo and Ce vs. the as-received austenitic AISI 304 stainless steel has been studied after isothermal oxidation in air at 900 8C for 32 h. The oxide layer formed was characterised by means of conventional X-ray diffraction, scanning electron microscopy energy-dispersion spectroscopy and X-ray absorption spectroscopy (XAS) techniques. The projected ranges of the implantation were calculated using the TRIM code. The results obtained by the most sensitive technique, XAS, show slight differences in the chemical composition of the oxide layer of the different ion-implanted sample. However, these chemical differences could determine a threshold between acceptable and non-acceptable oxidation behavior.

Pujol T. et al. [17] stated that the hydraulic performance of an ancient Spanish horizontal watermill. Previous studies of similar devices have focused on qualitative descriptions of their technical functioning, providing efficiency curves based on two-dimensional analytical approximations. In contrast, here we perform three-dimensional computational fluid dynamics (CFD) simulations that allow us to obtain quantitative values for both the hydraulic torque and the power. The results here found reveal how previous studies clearly overestimated the efficiency of these devices. Finally, we make use of the capabilities of CFDs by investigating the performance of a modified blade profile. The new design here proposed successfully increases the energy efficiency (up to 44%) in comparison with the classical one.

Souari L .and Hassairi M [18] stated that almost half the exploitation costs of sea water reverse osmosis plant are affected to the electricity costs. Therefore, it's crucial to control those, and firstly to evaluate it. Each case should be treated independently, since the need in electricity depends on different factors: sea water characteristics, values taken for RO sizing parameters, electromechanical components efficiency and, last but not least, choice of the system for hydraulic energy recovery of the concentrate. Energy recovery devices are an important part of any sea water reverse osmosis system, and any future decrease in specific energy consumption is dependent upon the further development and improvement in the performance of such devices. Recent technological innovations, such as energy recovery turbine, are required to reduce and improve the energy consumption. One of the simplest methods to operate a sea water RO unit is to run the pump at constant speed, to obtain the required membrane feed pressure through a feed throttle valve, and to recover the remaining brine energy via a Pelton turbine. Increasing hydraulic performances of Pelton turbines requires the optimisation of all components, taking into account their coupling. Until now the development of Pelton turbines has relied almost entirely on experimental and empirical knowledge and has not benefited from numerical flow simulation.
Sun L. et al. [19] This paper presents a brief review on the current progress in stimuli-responsive SMMs, from recent development in traditional shape memory alloys (SMAs) and shape memory polymers (SMPs) to newly emerged shape memory hybrids (SMHs), which open the door for ordinary people to design their own SMMs in a do-it-yourself (DIY) manner. The focus of this review is on twofold, namely phenomena, in particular those newly observed ones, and novel applications with great potential at present and in near future.

3. CONCLUSION:
In the present world, fossil fuels are getting exhausted at an alarming rate. Hydropower generation is of great significance. Pelton Turbine is prominent in its contribution towards the same. Distributer/ Manifold for the Pelton Turbine is used for maintaining pressure. BHEL, Bhopal manufactures Distributer/Manifold in the hydro turbine engineering division. The Distributer/Manifold under study is five jet type. The distributer/manifold is made up of different sections, the sections being made up of cylinders and cones (frustum and truncated type); cylindrical sections are 21 numbers and cone sections are 27 numbers joined together.

4.REFERENCES:

- **Alexander K.V. et al. [1]** stated that the design of four different specific speed micro hydro propeller turbines operating at heads between 4 m and 9 m, and their application to a wider range of heads and outputs by scaling.
- **Alexandera K.V.and Giddensb E.P. [2]** stated that the final stages of developing a modular set of cost-effective micro hydro schemes for site heads below those currently serviced by Pelton Wheels.
- **Alnaga A. et al. [3]** stated that the development of an automatic iterative procedure for optimal design of hydraulic turbine distributors.
- **Anagnostopoulos J. S.and Papantonis D. E. [4]** stated that an alternative numerical methodology is developed for a fast and effective simulation and analysis of the complex flow and energy conversion in Pelton impulse hydro turbines.
- **Atthanayake I.U. [5]** stated that Elementary mathematical formulas governing the power developed by the Pelton turbine and design were deduced in early 1883. At that time the principal sources of loss are identified as the energy remaining in water after

being discharged from the bucket, the heat developed by impact of water in striking the bucket, the fluid friction of the water in passing over the surface of the bucket, the loss of head in the nozzle.

- International Journal of Hydropower & Dams 2010 World Atlas & Industry Guide 2010 **(Wallington, Surrey, UK: Aqua Media Int'L)**
- Solemslie B W and Dahlhaug O G 2012 IOP Conference Series: Earth and Environmental Science 15 032005.
- **B.S. Mann [6]** stated that Boronizing of steels has been very effectively used in overcoming adhesive, sliding and abrasive wear.
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