SPECTROMECH

2021

TEHNIQUE POLYTECHNIC INSTITUTE

DEPARTMENT OF MECHANICAL ENGINEERING

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- To be a premier institute in pursuit of excellence in technical education and skill development committed to serve the society

Mission of the Institution

- To promote excellence in learning, teaching and technology transfer
- To improve the quality of skilled workforce through a structured programmed and professional skills training
- To inspire students to learn and facilitate their overall development with social orientation and values

Vision of the Department

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- To enhance the interaction with industry
- To produce competitive& employable Diploma Engineers
- To inculcate ethical & professional values among students

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- **Successful career (PEO #1):** To provide students strong foundation of technological fundamentals, necessary to analyze, design, manufacture using modern technological tools to become successful professional in real life world
- **Adaptability with new learning environment (PEO #2):** To build up the aptitude for an understanding of requirement analysis, ability to adopt new working environment and solves complex problem especially in multidisciplinary in nature
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FOREWORD

Heartily welcome to our seventh edition of Mechanical Engineering Technical magazine 'SPECTRO MECH' in 2021. We excited to report that the Department of Mechanical Engineering continues to grow to meet our vision of the department which is analyze by Faculty Course Assessment Report (FCAR). Mechanical Engineering is one of the largest enrolled departments in the collage with more than 440 under graduate student over the period of 2010-2021 more than 07 students are already placed at various companies as well as higher studies within the pandemic period. All the initiatives are possible by the efficient contributions of alumni, friends, faculty members and staffs.

I would like to express my appreciation to all the authors of the article in this issue of the Magazine. Our goal is to create quality education for the student of the twenty first century. The success of 'SPECTRO MECH' depends on energetic and joint effort of all stake holders of the Institution. I would appreciate your feedback and any suggestion for improvement.

Soumendra Nath Basu
Executive Director
Technique Polytechnic Institute

CONTENT

ANOTHER SOURCE OF RENEWABLE ENERGY: TIDAL ENERGY

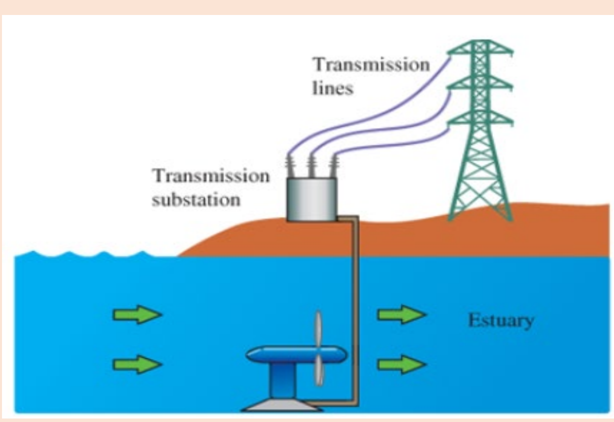
----- *Sujay Biswas, In-Charge, DME*

INTRODUCTION:

Tidal energy is produced by the surge of ocean waters during the rise and fall of tides. Tidal energy is a renewable source of energy. For most tidal energy generators, turbines are placed in tidal streams. A tidal stream is a fast-flowing body of water created by tides. A turbine is a machine that takes energy from a flow of fluid. That fluid can be air (wind) or liquid (water). Because water is much denser than air, tidal energy is more powerful than wind energy. Unlike wind, tides are predictable and stable. Where tidal generators are used, they produce a steady, reliable stream of electricity.

Placing turbines in tidal streams is complex, because the machines are large and disrupt the tide they are trying to harness. The environmental impact could be severe, depending on the size of the turbine and the site of the tidal stream. Turbines are most effective in shallow water. This produces more energy and allows ships to navigate around the turbines. A tidal generator's turbine blades also turn slowly, which helps marine life avoid getting caught in the system.

PRINCIPLE:



A tidal generator converts the energy of tidal flows into electricity. Greater tidal variation and higher tidal current velocities can dramatically increase the potential of a site for tidal electricity generation. Tidal energy is taken from the Earth's oceanic tides. Tidal forces result from periodic variations in gravitational attraction exerted by celestial bodies. These forces create corresponding motions or currents in the world's oceans. This results in periodic changes in sea levels, varying as the Earth rotates. These changes are highly regular and predictable, due to the consistent pattern of the Earth's rotation and the Moon's orbit around the Earth. The magnitude and variations of this motion reflect the changing positions of the Moon and Sun relative to the Earth, the effects of Earth's rotation, and local geography of the seafloor and coastlines.

Determine the theoretical energy stored in a barrage if the height of the tide is 3m in a barrage with an area of 300,000 m^2.

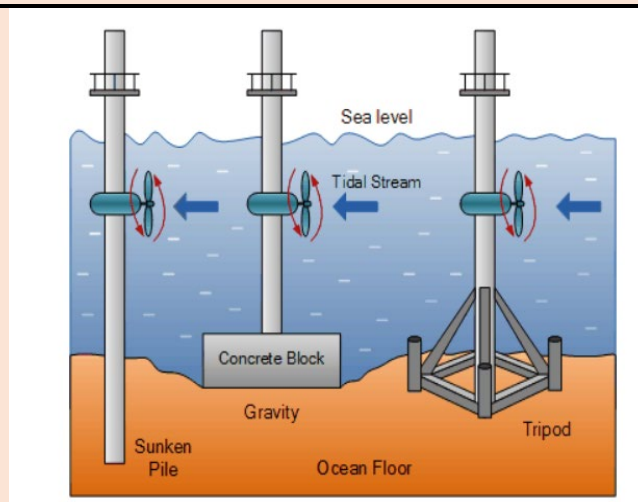
The barrage drains in 10 hours; calculate the average power.

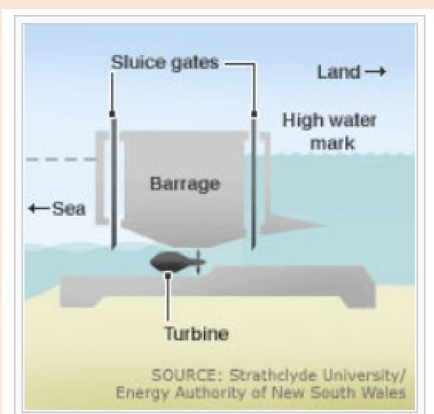
WPE=12ρAgh^2=12(1,025kgm^3)(300,000 m^2)(9.8ms^2)(3 m)^2=1.36×1010 J

P=WPEt=1.36×1010 J (10 hr.)(3,600)=377 kW

METHODS:

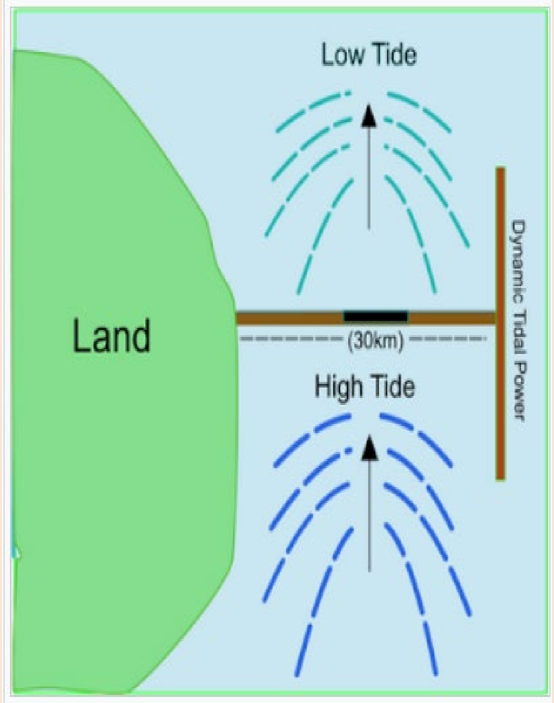
A. **Tidal stream generator:** Tidal stream generators make use of the kinetic energy of moving water to power turbines, in a similar way to wind turbines that use the wind to power turbines. Some tidal generators can be built into the structures of existing bridges or are entirely submersed, thus avoiding concerns over the impact on the natural landscape. Land constrictions such as straits or inlets can create high velocities at specific sites, which can be captured using of turbines. These turbines can be horizontal, vertical, open, or ducted.

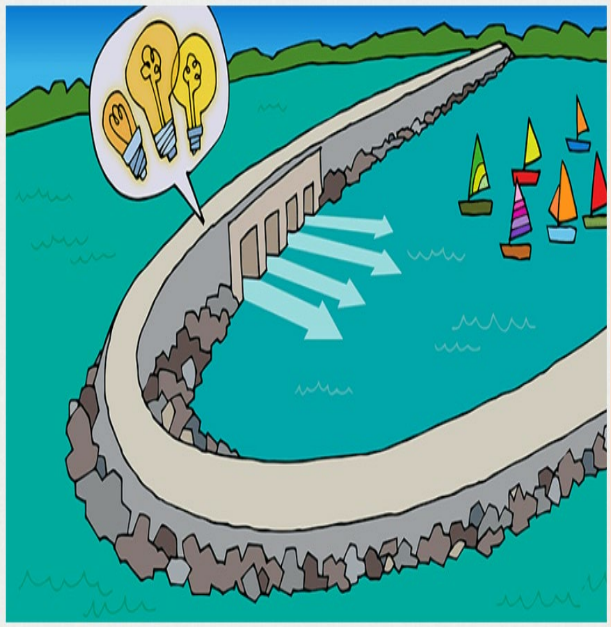




B. **Tidal barrages :** Tidal barrages use potential energy in the difference in height (or hydraulic head) between high and low tides. When using tidal barrages to generate power, the potential energy from a tide is seized through the strategic placement of specialized dams. When the sea level rises and the tide begins to come in, the temporary increase in tidal power is channelled into a large basin behind the dam, holding a large amount of potential energy. With the receding tide, this energy is then converted into mechanical energy as the water is released through large turbines that create electrical power through the use of generators. Barrages are essentially dams across the full width of a tidal estuary.

C. **Dynamic tidal power:** Dynamic tidal power (or DTP) is a theoretical technology that would exploit an interaction between potential and kinetic energies in tidal flows. It proposes that very long dams (for example: 30–50 km length) be built from coasts straight out into the sea or ocean, without enclosing an area. Tidal phase differences are introduced across the dam, leading to a significant water-level differential in shallow coastal seas – featuring strong coast-parallel oscillating tidal currents such as found in the UK, China, and Korea. Induced tides (TDP) could extend the geographic viability of a new hydro-atmospheric concept 'LPD' (lunar pulse drum) discovered by a Devon innovator in which a tidal 'water piston' pushes or pulls a metered jet of air to a rotary air-actuator & generator. The principle was demonstrated at London Bridge June 2019. Plans for a 30 m, 62.5kwh 'pilot' installation on a (Local Authority) tidal estuary shoreline in the Bristol Channel are underway.





D. **Tidal lagoon:** A new tidal energy design option is to construct circular retaining walls embedded with turbines that can capture the potential energy of tides. The created reservoirs are similar to those of tidal barrages, except that the location is artificial and does not contain a pre-existing ecosystem. The lagoons can also be in double (or triple) format without pumping or with pumping that will flatten out the power output. The pumping power could be provided by excess to grid demand renewable energy from for example wind turbines or solar photovoltaic arrays. Excess renewable energy rather than being curtailed could be used and stored for a later period of time. Geographically dispersed tidal lagoons with a time delay between peak production would also flatten out peak production providing near baseload production at a higher cost than other alternatives such as district heating renewable energy storage. The cancelled Tidal Lagoon Swansea Bay in Wales, United Kingdom would have been the first tidal power station of this type once built.

❖ Current and future tidal power schemes:

i. The Rance tidal power plant built over a period of 6 years from 1960 to 1966 at La Rance, France. It has 240 MW installed capacity.
ii. 254 MW Sihwa Lake Tidal Power Plant in South Korea is the largest tidal power installation in the world. Construction was completed in 2011.
iii. The first tidal power site in North America is the Annapolis Royal Generating Station, Annapolis Royal, Nova Scotia, which opened in 1984 on an inlet of the Bay of Fundy. It has 20 MW installed capacity.
iv. The Jiangxia Tidal Power Station, south of Hangzhou in China has been operational since 1985, with current installed capacity of 3.2 MW. More tidal power is planned near the mouth of the Yalu River.

❖ Issues and challenges:

Environmental concerns: Tidal power can affect marine life. The turbines' rotating blades can accidentally kill swimming sea life. Projects such as the one in Strangford include a safety mechanism that turns off the turbine when marine animals approach. However, this feature causes a major loss in energy because of the amount of marine life that passes through the turbines. Some fish may avoid the area if threatened by a constantly rotating or noisy object. Marine life is a huge factor when siting tidal power energy generators.

Tidal turbines: The main environmental concern with tidal energy is associated with blade strike and entanglement of marine organisms as high-speed water increases the risk of organisms being pushed near or through these devices. As with all offshore renewable energies, there is also a concern about how the creation of electromagnetic fields and acoustic outputs may affect marine organisms. Because these devices are in the water, the acoustic output can be greater than those created with offshore wind energy.

Fouling: The biological events that happen when placing any structure in an area of high tidal currents and high biological productivity in the ocean will ensure that the structure becomes an ideal substrate for the growth of marine organisms. In the references of the Tidal Current Project at Race Rocks in British Columbia, this is documented. Also see this page and Several structural materials and coatings were tested by the Lester Pearson College divers to assist Clean Current in reducing fouling on the turbine and other underwater infrastructure.

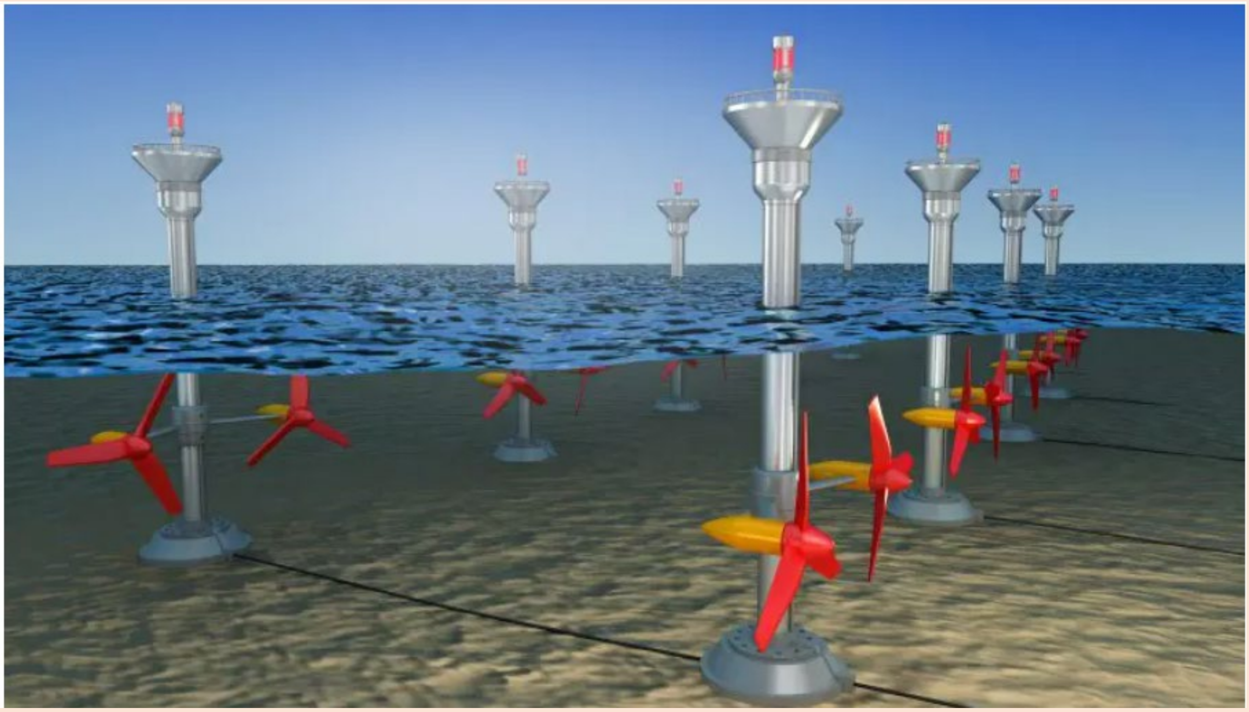
Cost

Tidal energy has a high initial cost, which may be one of the reasons why it is not a popular source of renewable energy. The methods of generating electricity from tidal energy are relatively new technology. It is projected that tidal power will be commercially profitable within 2020.

Conclusion:

Electricity generation from marine technologies increased an estimated 16% in 2018, and an estimated 13% in 2019.Policies promoting R&D are needed to achieve further cost reductions and large-scale development. Because the Earth's tides are ultimately due to gravitational interaction with the Moon and Sun and the Earth's rotation, tidal power is practically inexhaustible, and is thus classified as a renewable energy resource. Movement of tides causes a loss of mechanical energy in the Earth-Moon system: this results from pumping of water through natural restrictions around coastlines and consequent viscous dissipation at the seabed and in turbulence.

A tidal generator converts the energy of tidal flows into electricity. Greater tidal variation and higher tidal current velocities can dramatically increase the potential of a site for tidal electricity generation in future.



Failure Analysis And Cost Analysis Of C.I. Flange Coupling

-By Sujit Kumar Garai, Course-in Charge, DME

Abstract— **A Coupling is a device which transmits power between two shafts rotating at designed speed. It is the important part of any power transmission system and may continue long time if design and cost analysis is maintained properly and the product can be chosen by the users. The present study of this paper is to reduce the cost of production by selecting proper designing process. The stress analysis that acting on the bolts, keys, hub and flange by making it uniform strengthens. The stress in the threaded part of the bolt will be higher than that in the shank. Hence a greater portion of the bolt will be absorbed at the region of the threaded part which may fracture the threaded portion because of its small length. An axial hole is drilled at the centre of the bolt through the head as far as thread portion such that the stress in the bolt is uniformly distributed along the length of the bolt. This consideration may also be taken in designing hub and flange. A special care should be taken during operation of key way in the hub portion to avoid stress concentration in keys and hub. In this paper there are explanation of detailed designing process for effective cost analysis.**

Keywords— Shearing, Crushing, Uniform Strength, Cost analysis.

Introduction

A coupling is a device that serves to connect the ends of adjacent shafts which are co-axial or non-co-axial. Couplings are basically of two types: 1. Rigid couplings 2. Flexible couplings. Rigid coupling is also classified into - Sleeve or muff coupling, Clamp or split-muff or compression coupling and Flange coupling. Similarly Flexible coupling also classified as - Bushed pin type coupling, Universal coupling and Oldham coupling. The strength of coupling mainly depends on designing process consider, material and workmanship. The cost of coupling is also main considerable factor in the competitive market. In this paper the designing and cost calculations are explained in details.

Objectives of shaft couplings used in machinery are -

- **To provide for the connection of shafts of units that are manufactured separately such as a motor and generator and to provide for disconnection for repairs or alternations.**
- **To provide for misalignment of the shafts or to introduce mechanical flexibility.**
- **To reduce the transmission of shock loads from one shaft to another.**
- **To introduce protection against overloads.**
- **It should have no projecting parts.**

Rigid couplings are used when precise shaft alignment is required; any shaft misalignment will affect the coupling's performance as well as its life span, because rigid couplings do not have the ability to compensate for misalignment. Due to this, their application is limited, and they're typically used in

applications involving vertical drivers. Requirements of good coupling are - Easy to connect or disconnect the coupling, this does allow some misalignment between the two adjacent shaft rotation axes, no projecting parts, goal should be to minimize the remaining misalignment in running operation so as to maximize power transmission and to maximize machine runtime. It is recommended to use manufacturer's alignment target values to set up the machine train to a defined non-zero alignment, due to the fact that later, when the machine is at operation temperature, the alignment condition is perfect.

Design and calculations

Problem statement:

Design and cost estimation of a C.I. unprotective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The permissible stresses are:

1) Shear stress for shaft, bolt & key = 40 Mpa

2) Crushing stress for bolt & key = 80 Mpa

3) Shear stress for cast iron = 8 Mpa

Input data for CI flange coupling –

1. Power – 15kW
2. RPM - 900
3. Shear stress for shaft, bolt and key =40Mpa
4. Crushing stress for bolt and key =80Mpa
5. Shear stress for cast iron =8Mpa

Service factor = 1.35 STEP - 1

Design of Shaft:

$P = \frac{2\pi N T_m x 100}{60}$

$T_m = \frac{15x60x1000}{2x\pi x900} = 159.15$ N-m

$T_{max} = 1.35x159.15 = 215$ N-m

$\frac{\pi}{16} * d^3 * \tau = 215 * 10^3 \quad d = \sqrt[3]{\frac{16\ x\ 215x\ 10^3}{\pi\ x\ 40}}$

=30.13 =35mm (according to market availability)

STEP - 2

Design of Hub:

Outer diameter of hub = D=70mm

Inner diameter of hub = d =35mm

Length of the hub = L =52.5mm

Maximum shear stress developed in the outmost layer of the Hub material = τ_h

Torque $(T_{max}) = \frac{\pi}{16}\left(\frac{D^4-d^4}{d}\right) * \tau_h$

$\tau_h = \frac{16*215*103*70}{(704-354)*\pi}$

=3.40 Mpa

STEP - 3

Design of Key:

Width of the key = w = $\frac{d}{4} = \frac{35}{4}$ **= = 10mm**

Thickness of key = t = $\frac{d}{6} = \frac{35}{6}$ **= 8mm**

Length of the key = l_k **= 52.5mm**

1. **Consider shearing failure :**

Shearing resisting area = $w*l_k$

$T_{max} = w*l_k*\tau*\frac{d}{2}$

$\tau = \frac{215*103*2}{10*52.5*35}$ **= 23.40 Mpa**

2. **Consider Crushing Failure**

Crushing Resisting Area

$= t / 2 * l_k$

$T_{max} = \frac{t}{2} * l_k * \sigma_c * \frac{d}{2}$

$\sigma_c = \frac{215*1000*4}{52.5*8*5}$ **= 58MPa**

STEP - 4

Design of Flange:

t_f**=17.5mm**

Consider shearing failure at the junction of Hub.

Shearing resisting area = $\pi*d*t_f$

$T_{max} = \pi*d*t_f*\tau*\frac{d}{2}$

$\tau_H = \frac{215*1000*2}{\pi*35*17.5*35}$ **= 6.38 MPa.**

STEP - 5

Design of bolt:

No. of bolt (n) = 4 / 150 * d * 3 4 / 150 * 35 + 3 10^3

$= 3.93 \approx 4$

$T_{max} = \frac{\pi}{4} * d_b^2 * 4 * \tau * \frac{D1}{2}$

$d_b = \sqrt{\frac{215 * 8 * 10^3}{\pi * 4 * 40 * 105}}$

= 5.70 mm

= 8 mm (according to market availability)

Material Cost of Flange & Hub:

Total volume of flanges and hubs

$= [\frac{\pi}{4}\{(70^2 - 35^2) * 52.5 + (140^2 - 70^2) * 17.5\}]$

$= 3.53 \times 10^5\ mm^3$

For two flanges and hubs

$= 3.53 * 10^5 * 2$

$= 7.06 * 10^5\ mm^3$

Density of CI = 7.8gm/cc

Weight of two flanges and hubs

$= 7.06 * 10^5 / 10^3 * 7.8 / 1000$

= 5.5 kg

One kg of cast iron price is Rs. 78

Then, 5.5 kg of cast iron price is = 5.5*78

= Rs.430/-

Material Cost of Bolts:

Volume of hexagonal bolt = $2.59 * (8)^2 * 8$, (where, a = 8)

$= 1.32 * 10^3\ mm^3$

Length of the bolt = (17.5+17.5) +8

= 43 ≈ 50mm

Volume of 4 bolts = $4 * (1.32 * 10^3 + 2.51 * 10^3)$

$= 15320\ mm^3$

Total weight of bolts = 15320/1000*7.85/1000

= 0.120kg

Material cost for bolts = 50*0.120

Where, 1kg = Rs.50

= Rs.6/-

Material Cost of Key:

Volume of the key = 10*8*60

$= 4800\ mm^3$

For two keys,

Volume = 4800*2 = $9600\ mm^3$

Weight of the key = 9600/1000*7.85/1000

= 0.075kg

Cost of the key = 50 * 0.075

= 4/- [Where, 1kg = Rs.50]

So, total material cost for flange coupling = 430+6+4

= Rs.440

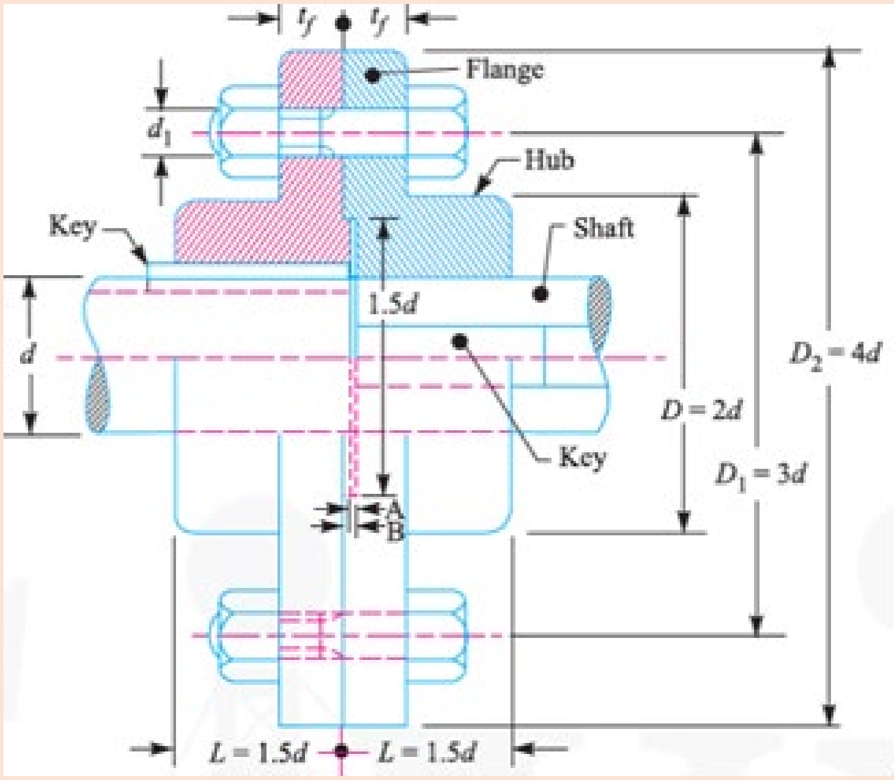


FIGURE I. SECTIONAL VIEW OF FLANGED COUPLING

TABLE I. DETAILS OF STRESS & COST ANALYSIS

Stress and Material cost summary				
	Component & materials	Input stress in MPa	Designed stress in MPa	Cost per unit (Rs.)
1.	Shaft M.S.	Shear stress 40	Shear stress 25.54	
2.	Hub C.I.	Shear stress 8	Shear stress 3.40	430/-
3.	Flange C.I.	Shear stress 8	Shear stress 6.38	
4.	Bolt M.S.	Shear stress 40	Shear stress 20.37	4 * 1.5/-
5.	Key M.S.	Shear stress 40	Shear stress 23.40	4/-
		Crushing stress 80	Crushing stress 58	
6.	Total Cost			440/-

CONCLUSION

From the design calculations of flange coupling it is concluded that all dimensions of different parts of coupling are safe to transmit input power. The cost of the coupling is reasonable in competitive market. For future work, in the analysis process computerized fuzzy logic techniques will be utilized to reduce the error of design calculation and cost calculation.

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Biodiesel-World Future Energy Source

--by ABHIJIT HAZRA, *Lecturer, DME*

Introduction

Biofuels are drawing increasing attention worldwide as substitutes for petroleum-derived transportation fuels to help address energy cost, energy security and global warming concerns associated with liquid fossil fuels. The term biofuel is used here to mean any liquid fuel made from plant material that can be used as a substitute for petroleum-derived fuel. Biofuels can include relatively familiar ones, such as ethanol made from sugar cane or diesel-like fuel made from soybean oil, to fewer familiar fuels such as dimethyl ether (DME) or Fischer-Tropsch liquids (FTL) made from lignocellulosic biomass.

Biodiesel refers to a vegetable oil – or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, ethyl, or propyl) esters. Biodiesel can be used as a pure fuel or blended with petroleum in any percentage. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix:

a) 100% biodiesel is referred to as B100
b) 20% biodiesel, 80% Petro diesel is labelled B20
c) 5% biodiesel, 95% Petro diesel is labelled B5
d) 2% biodiesel, 98% Petro diesel is labelled B2

Blends of 20% biodiesel and lower can be used in diesel equipment with no, or only minor modification.

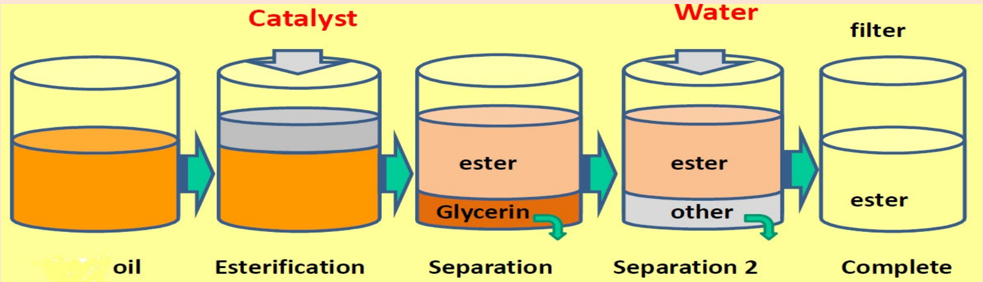
Benefits of Biodiesel

a) Produced from Renewable Resources.
b) Can be Used in existing Diesel Engines.
c) Grown, Produced and Distributed Locally.
d) Biodegradable and Non-Toxic.
e) Better Fuel Economy.
f) Reductions in greenhouse gas emissions, deforestation, pollution.

Literature View:

Continued use of petroleum-based fuels is now widely recognized as unsustainable because of depleting supplies and contribution of these fuels to pollute the environment. The challenge, therefore, is to secure adequate energy supplies at the least possible cost. Over 1.5 trillion barrels of oil equivalent have been produced since Edwin Drake drilled the world's first oil well in 1859. Economic growth is always accompanied by commensurate increase in the transport. The high energy demand in the industrialized world as well as in the domestic sector, and pollution problems caused due to the widespread use of fossil fuels make it increasingly necessary to develop the renewable energy sources of limitless duration and smaller environmental impact than the traditional one. One possible alternative to fossil fuel is the use of oils of plant origin like vegetable oils and non-edible oils. Usage of biodiesel will allow a balance to be sought between agriculture, economic development and the environment. The aim of this article is to investigate to hidden possibilities of biodiesel utilization in Hungary by the review of international literature. Biodiesel is derived from biological sources, such as vegetable oils or fats, and alcohol (3, 6). Commonly used feedstocks are shown in Table.

Vegetable Oils	Animal Fats	Other Sources
Soybeans Rapeseed Canola Oil (a modified version of rapeseed) Safflower Oil	Lard Tallow Poultry Fat	Recycled Restaurant Cooking Oil (a.k.a. Yellow Grease)



Most commercial biodiesel is made by a chemical process called transesterification. This involves mixing the feedstock oil with an alcohol – typically methanol or ethanol – in the presence of a catalyst, such as sodium hydroxide or potassium hydroxide. The reaction produces methyl esters (if methanol is used) or ethyl esters (if ethanol is used) – which comprises the biodiesel fuel – and glycerine. Methanol is typically used for economic reasons, as the physical and chemical properties between methyl esters and ethyl esters are, according to a University of Idaho study, "comparable".

Stages of Biodiesel Production Process:

1. Treatment of raw materials.
2. Alcohol-catalyst mixing.
3. Chemical reaction.
4. Separation of the reaction products.
5. Purification of the reaction products.

- Treatment of raw materials:
  The content of free fatty acids, water and non-saponifiable substances are key parameters to achieve high conversion efficiency in the transesterification reaction.

  - Acidity level <0.1 mg KOH/g
  - Humidity <500 ppm
  - Peroxide index<10 meq/kg
  - Non-saponifiable substances <1%.

- Alcohol-catalyst mixing:
  The alcohol used for biodiesel production must be mixed with the catalyst before adding the oil. The mixture is stirred until the catalyst is completely dissolved in the alcohol. Sodium and potassium hydroxides are among the most widely used basic catalysts. For production on an industrial scale, sodium or potassium methoxides or methylates are commercially available.

➢ Chemical reaction:

The absence of mono- and diglycerides at the beginning of the chemical reaction and the increase and reduction of their concentration during the reaction confirm that the production of esters from the triglycerides takes place in three steps, as represented in the equations below:

$$TG + MOH = DG + ME$$
$$DG + MOH = MG + ME$$
$$MG + MOH = G + ME$$

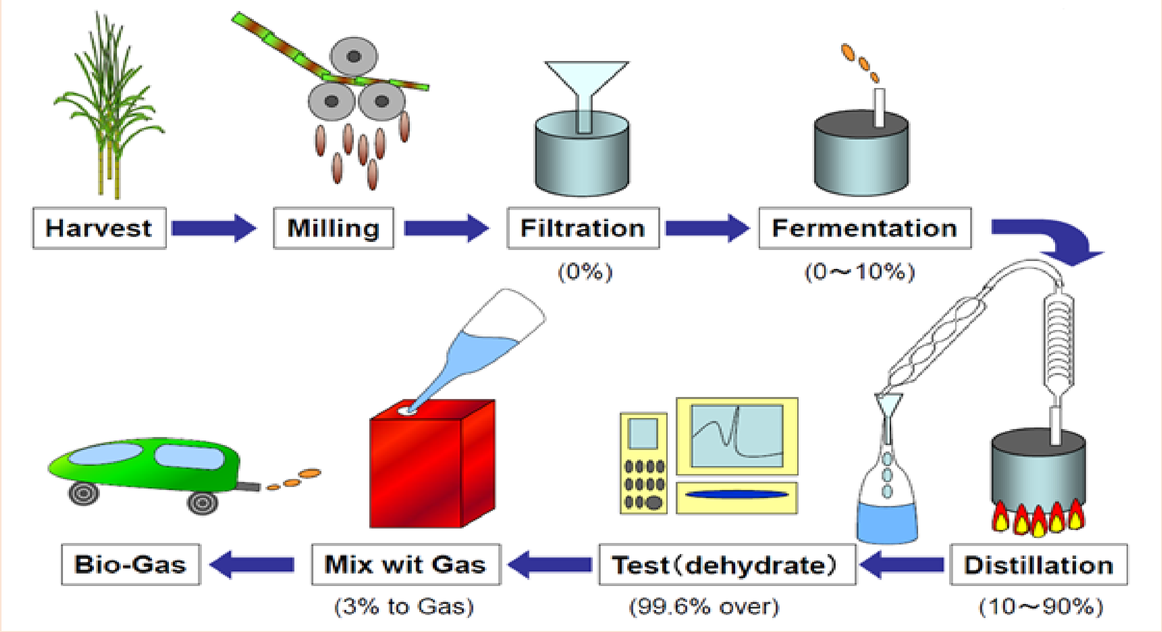
where MOH indicates methanol, ME are the methyl esters, TG, DG and MG are tri-, di- and monoglycerides, respectively, and G is the glycerin.

➢ Separation of the reaction products:

The separation of reaction products takes place by decantation: the mixture of fatty acids methyl esters (FAME) separates from glycerine forming two phases, since they have different densities; the two phases begin to form immediately after the stirring of the mixture is stopped. Due to their different chemical affinities, most of the catalyst and excess alcohol will concentrate in the lower phase (glycerine), while most of the mono-, di-, and triglycerides will concentrate in the upper phase (FAME).

➢ Purification of the Reaction Products:

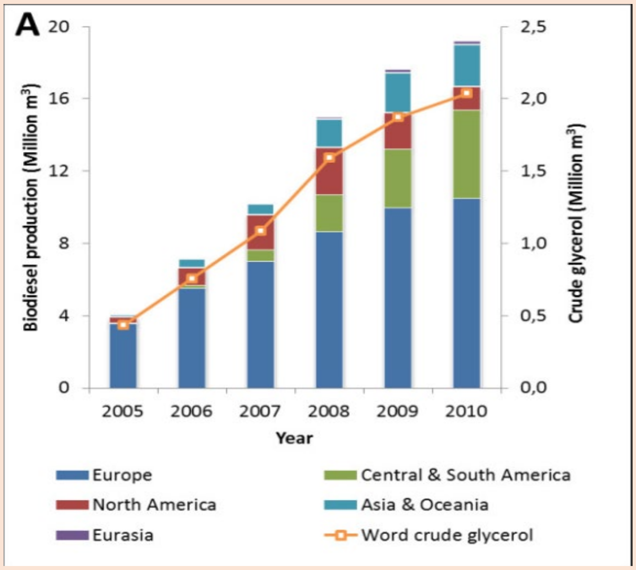
The mixture of fatty acids methyl esters (FAME) obtained from the transesterification reaction must be purified in order to comply with established quality standards for biodiesel. Therefore, FAME must be washed, neutralized and dried. Successive washing steps with water remove the remains of methanol, catalyst and glycerine, since these contaminants are water-soluble. Care must be taken to avoid the formation of emulsions during the washing steps, since they would reduce the efficiency of the process.

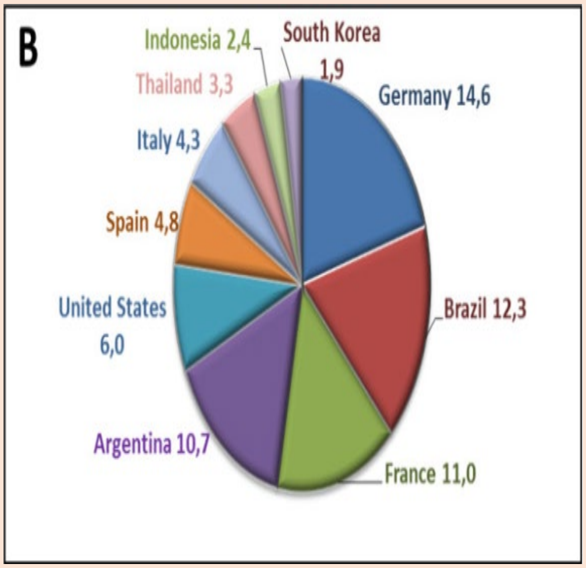


Current scenario of biofuel production in India

a) Currently, India's position in global biofuel map is not very prominent and contributes only 1% of the global production.

b) It will be estimated about 380 million liters of ethanol and 45 million liters of biodiesel production in recent years.
c) The Government of India has approved the "National policy of biofuels" (Ministry of New and Renewable Energy) on December 24, 2009. Since then, considerable advancements have taken place in the direction of cultivation, production and use of biofuels.
d) It has addressed the global concern about containment of carbon emission through use of environmentally friendly biofuels.





HIGH PRESSURE BOILERS

By Anupam Barik, *Lecturer, DME*

Introduction to High Pressure Boilers:

According to the American Society of Mechanical Engineers (ASME) a 'steam generating unit' is defined as:

"A combination of apparatus for producing, furnishing or recovering heat together with the apparatus for transferring the heat so made available to the fluid being heated and vaporised".

In simple, a boiler may be defined as a closed vessel in which steam is produced from water by combustion of fuel.

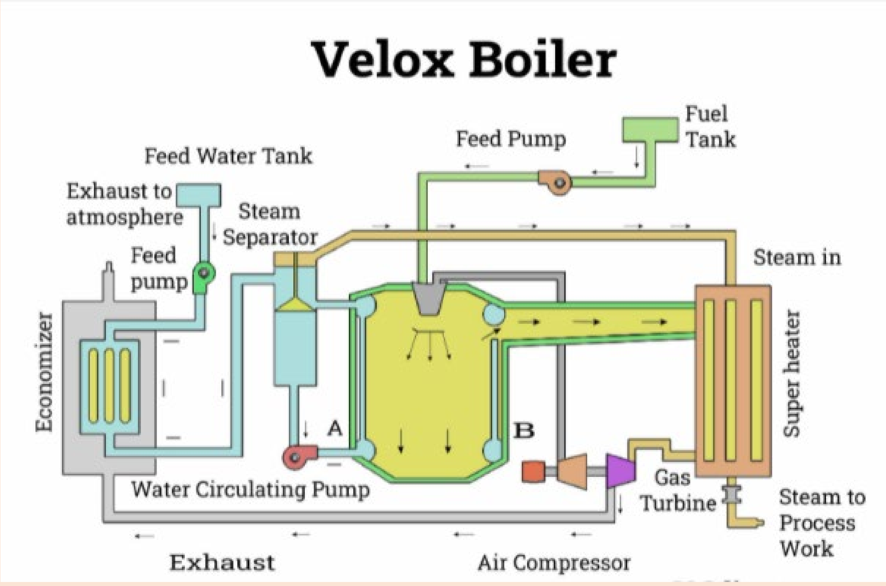
The steam generated is employed for the following purposes:

(i) For generating power in steam engines or steam turbines.

(ii) In the textile industries for sizing and bleaching etc., and many other industries like sugar mills; chemical industries.

(iii) For heating the buildings in cold weather and for producing hot water for hot water supply.

In applications where steam is needed at pressure, 30 bar, and individual boilers are required to raise less than about 30000 kg of steam per hour, shell boilers are considerably cheaper than the water-tube boilers. Above these limits, shell boilers (generally factory built) are difficult to transport if not impossible. There are no such limits to water-tube boilers.



These can be site erected from easily transportable parts, and moreover the pressure parts are of smaller diameter and therefore can be thinner. The geometry can be varied to suit a wide range of situations and furnace is not limited to cylindrical form. Therefore, water- tube boilers are generally preferred for high pressure and high output, whereas, shell boilers for low pressure and low output.

The modern high-pressure boilers employed for power generation are for steam capacities 30 to 650 tonnes/h and above with a pressure up to 160 bar and maximum steam temperature of about 540°C.

Unique Features of the High Pressure Boilers:

1. Method of Water Circulation:

The circulation of water through the boiler may be natural circulation due to density difference or forced circulation. In all modern high pressure boiler plants, the water circulation is maintained

with the help of pump which forces the water through the boiler plant. The use of natural circulation is limited to sub-critical boilers due to its limitations.

2. Type of Tubing:

In most of the high pressure boilers, the water is circulated through the tubes and their external surfaces are exposed to the flue gases. In Water-tube boilers, if the flow takes place through one continuous tube, the large pressure drop takes place due to friction.

This is considerably reduced by arranging the flow to pass through parallel system of tubing. In most of the cases, several sets of the tubing are used. This type of arrangement helps to reduce the pressure loss, and better control over the quality of the steam.

3. Improved Method of Heating:

The following improved methods of heating may be used to increase the heat transfer:

(i) The saving of heat by evaporation of water above critical pressure of the steam.

(ii) The heating of water can be made by mixing the superheated steam. The mixing phenomenon gives highest heat transfer coefficient.

(iii) The overall heat transfer coefficient can be increased by increasing the water velocity inside the tube and increasing the gas velocity above sonic velocity.

Advantages of High-Pressure Boilers:

The following are the advantages of high-pressure boilers:

1. In high pressure boilers pumps are used to maintain forced circulation of water through the tubes of the boiler. This ensures positive circulation of water and increases evaporative capacity of the boiler arid less number of steam drums will be required.

2. The heat of combustion is utilized more efficiently by the use of small diameter tubes in large number and in multiple circuits.

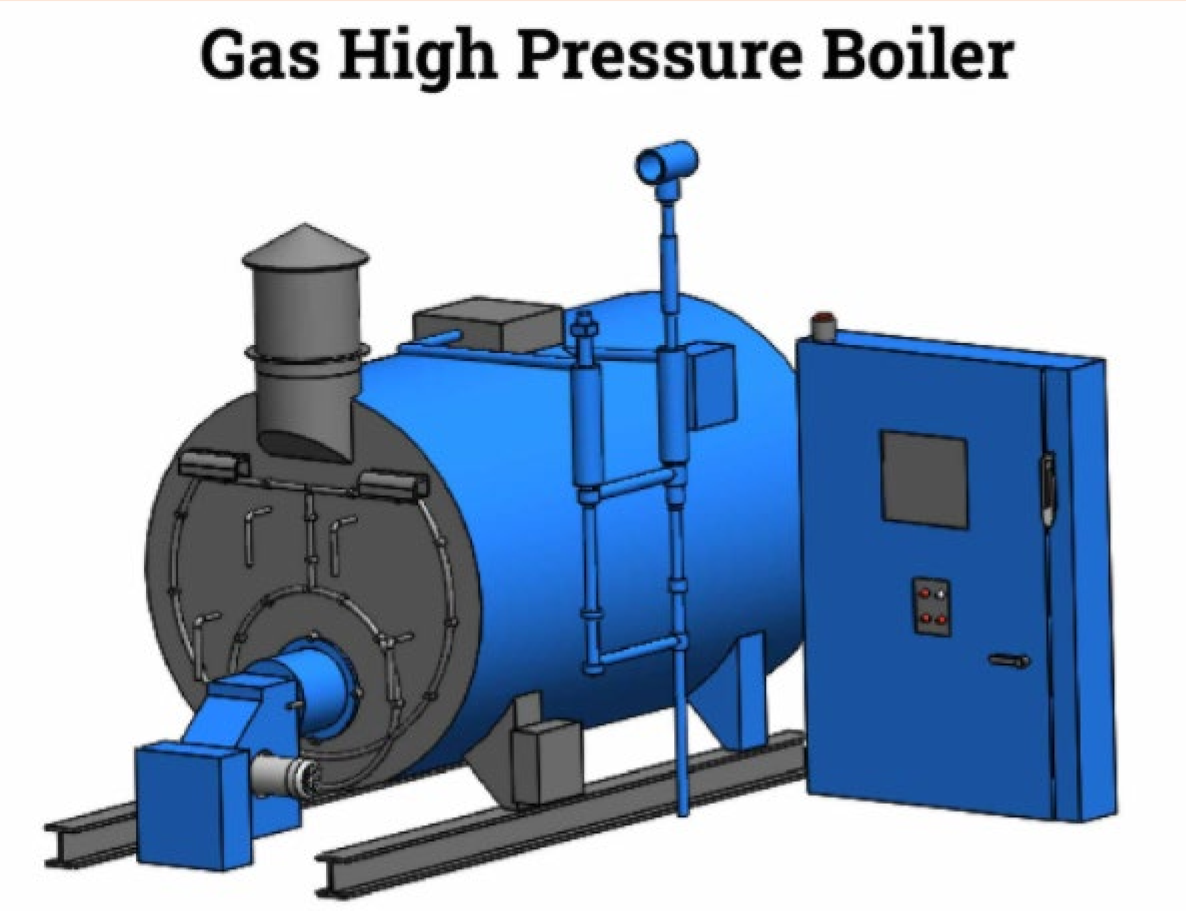
3. Pressurized combustion is used which increases rate of firing of fuel thus increasing the rate of heat release.

4. Due to compactness less floor space is required.

5. The tendency of scale formation is eliminated due to high velocity of water through the tubes.

6. All the parts are uniformly heated; therefore, the danger of overheating is reduced and thermal stress problem is simplified.

7. The differential expansion is reduced due to uniform temperature and this reduces the possibility of gas and air leakages.



History Of Hacksaw Blade

- by Tarun Chakraborty, Workshop Instructor , DME

Introduction:

While saws for cutting metal had been in use for many years, significant improvements in longevity and efficiency were made in the 1880s by Max Flower-Nash. George N. Clemson, a founder of Clemson Bros. Inc of Middletown, New York, United States, conducted tests which involved changing the dimensions, shapes of teeth, styles of set, and variable heat treatments of blades. Clemson claimed enormous improvements to the cutting ability of blades and built a major industrial operation manufacturing hacksaw blades sold under the trade name Star Hack Saw. In 1898, Clemson was granted US Patent 601947, which details various improvements in the hacksaw.

A woman using a hacksaw for vocational training during the Second World War

Design and Development of hacksaw blade:

Standard hacksaw blade lengths are 10 to 12 in (250 to 300 mm). Blades can be as small as 6 in (150 mm). Powered hacksaws may use large blades in a range of sizes, or small machines may use the same hand blades. The pitch of the teeth can be from fourteen to thirty-two teeth per inch (TPI) for a hand blade, with as few as three TPI for a large power hacksaw blade. The blade chosen is based on the thickness of the material being cut, with a minimum of three teeth in the material. As hacksaw teeth are so small, they are set in a "wave" set. As for other saws they are set from side to side to provide a kerf or clearance when sawing, but the set of a hacksaw changes gradually from tooth to tooth in a smooth curve, rather than alternate teeth set left and right. Hacksaw blades are normally quite brittle, so care needs to be taken to prevent brittle fracture of the blade. Early blades were of carbon steel, now termed 'low alloy' blades, and were relatively soft and flexible. They avoided breakage, but also wore out rapidly. Except where cost is a particular concern, this type is now obsolete. 'Low alloy' blades are still the only type available for the Junior hacksaw, which limits the usefulness of this otherwise popular saw. For several decades now, hacksaw blades have used high speed steel for their teeth, giving greatly improved cutting and tooth life. These blades were first available in the 'All-hard' form which cut accurately but were extremely brittle. This limited their practical use to benchwork on a workpiece that was firmly clamped in a vice. A softer form of high-speed steel blade was also available, which wore well and resisted breakage, but was less stiff and so less accurate for precise sawing. Since the 1980s, bi-metal blades have been used to give the advantages of both forms, without risk of breakage. A strip of high-speed steel along the tooth edge is electron beam welded to a softer spine. As the price of these has dropped to be comparable with the older blades, their use is now almost universal. The most common blade is the 12 inch or 300 mm length. Hacksaw blades have a hole at each end for mounting them in the saw frame and the 12 inch / 300 mm dimension refers to the center-to-center distance between these mounting holes. The kerf produced by the blades is somewhat wider than the blade thickness due to the set of the teeth. It commonly varies between 0.030 and 0.063 inches / 0.75 and 1.6 mm depending on the pitch and set of the teeth.

A *panel hacksaw* has a frame made of a deep, thin sheet aligned behind the blade's kerf, so that the saw could cut into panels of sheet metal without the length of cut being restricted by the frame. The frame follows the blade down the kerf into the panel. *Junior hacksaws* are a small version with a half-size blade. Like coping saws, the blade has pins that are held by notches in the frame. Although potentially a useful tool for a toolbox or in confined spaces, the quality of blades in the Junior size is restricted and they are only made in the simple low alloy steels, not HSS. This restricts their usefulness. A *power hacksaw* (or *electric hacksaw*) is a type of hacksaw that is powered either by its own electric motor or connected to a stationary engine. Most power hacksaws are stationary machines but some portable models do exist; the latter (with frames) have been displaced to some extent by reciprocating saws such as the Sawzall, which accept blades with hacksaw teeth. Stationary models usually have a mechanism to lift up the saw blade on the return stroke and some have a coolant pump to prevent the saw blade from overheating. Power hacksaws are not as commonly used in the metalworking industries as they once were. Bandsaws and cold saws have mostly displaced them. While stationary electric hacksaws are not very common, they are still produced. Power hacksaws of the type powered by stationary engines and line shafts, like other line-shaft-powered machines, are now rare; museums and antique-tool hobbyists still preserve a few of them.

Use:

Hacksaws were originally and principally made for cutting metal, but can also cut various other materials, such as plastic and wood; for example, plumbers and electricians often cut plastic pipe and plastic conduit with them.