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Начало Теории Состояний Транспортных Поток. Вывод И Решение Уравнений Состояний

Бу Профессор В.И.Гук

абстрактный - Из позиции теории систем движение транспортного потока является непрерывным изменением его состояния, что в упрощенной форме представляет собой переменную (вектор) и вместе со входной информацией (интенсивностью или скоростью) полностью определяет динамику транспортного потока. Поэтому, если рассматривать транспортный поток сам по себе, без входной интенсивности или скорости, то знание состояния потока в *i-тый* момент времени (вместе со знанием структуры и параметров) достаточно для того, чтобы предусмотреть его будущее движение (поведение). Начальные условия дифференциального уравнения также будут являть собой вектор состояния [37, 41, 64, 65]. Понятие состояние тесно связано с понятиями тип колебаний или гармоника. Через то, что состояние объекта не поддается непосредственному измерению, а измеряемые величины, изменяются препятствиями, состояние объекта может быть только оценено.

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препятствиями, состояние объекта может быть только оценено.

Введение

Как указывается в [19] в общем значении «состояние системы в момент t является таким набором данных о поведении системы, которого вместе с некоторым возможным входным влиянием, заданным при $t_0 < t < t_i$, достаточно для однозначного определения исходного сигнала для $t_0 < t < t_i$ при любом $t_i > t_0$ ».

Для транспортного потока, описываемого дифференциальными уравнениями первого порядка, начальное условие в момент t_0 будет состоянием потока в момент t_0 .

$$\frac{d}{dt} \frac{\partial}{\partial \dot{x}} \int J d\dot{x} - \frac{\partial}{\partial x} \int J d\dot{x} + \frac{\partial}{\partial x} \int \frac{1}{C} dx + \frac{d}{dt} \int Q dx = \frac{d}{dt} \int N dx \quad (1.1)$$

$$\frac{d}{dt} \frac{\partial}{\partial \dot{\lambda}} \int C d\dot{\lambda} - \frac{\partial}{\partial \lambda} \int C d\dot{\lambda} + \frac{\partial}{\partial \lambda} \int \frac{1}{J} d\lambda + \frac{d}{dt} \int \frac{1}{Q} d\lambda = \frac{d}{dt} \int V dt. \quad (1.2)$$

$$\frac{\partial}{\partial \dot{x}} \int J d\dot{x} = JV; \quad \frac{\partial}{\partial x} \int J d\dot{x} = 0; \quad \frac{\partial}{\partial x} \int \frac{1}{C} dx = \frac{x}{C}; \quad \int Q dx = Qx; \quad (2.1)$$

$$\frac{\partial}{\partial \dot{\lambda}} \int C d\dot{\lambda} = CN; \quad \frac{\partial}{\partial \lambda} \int C d\dot{\lambda} = 0; \quad \frac{\partial}{\partial \lambda} \int \frac{1}{J} d\lambda = \frac{\lambda}{J}; \quad \int \frac{1}{Q} d\lambda = \frac{\lambda}{Q}. \quad (2.2)$$

где x -дистанция, dx и V – скорость, J – инерционность, C - напряженность, – количество потока, Q – плотность, λ - интенсивность потока.

Соотношение (1.1), (1.2) и (2.1), (2.2) будем рассматривать как стандартную форму состояния, потому что выражение (1) является уравнением состояния, а выражение (2.) — уравнением типа вход — состояние — выход.

Далее рассмотрим уравнение движения потока вида

$$J \frac{dV}{dt} + QV(t) = N(t), \quad \text{для } t \geq 0, \quad (3)$$

или замеща

$$J\dot{V}(t) + QV(t) = N(t), \quad \text{для } t \geq 0,$$

отсюда

$$\dot{V}(t) = -\frac{Q}{J} V(t) + \frac{1}{J} N(t), \quad \text{для } t \geq 0$$

$$V(t) = V(0) + \int_0^t \frac{1}{J} e^{-Q(t-\tau)/J} N(\tau) d\tau \quad \text{для } t \geq 0. \quad (4)$$

Скорость $V(0)$ и входная интенсивность однозначно определяют скорость потока $V(t)$ при любом $t > 0$. Также, задавая скорость $V(t)$, любую переменную величину транспортного потока определим и так:

$$N_0(t) = QV(t), \quad \lambda(t) = JV(t) \quad (5)$$

автор : доктор технических наук.

Поэтому скорость V на подходе к перекрестку можно назвать состоянием транспортного потока в зоне участков улиц и дорог с препятствиями (перекресток, подъемы, знаки и т. п.).

Известно, что состояние — понятие абстрактно и может быть представлено разными способами. Поэтому, учитывая рекомендации [19, 66], дадим общее определение состоянию транспортного потока: Совокупность данных, которые характеризуют транспортный поток как динамическую систему, назовем состоянием транспортного потока, который должен удовлетворять такие два условия:

1. Для любого времени t состояние при t_i и заданных формах (волны) функций входных интенсивности или скорости, которые определены для t и дальше, однозначно определяется для любого времени $t > t_i$.
2. Состояние в момент времени t и входная интенсивность или скорость при t (или их производные) определяют однозначное значение любой переменной транспортного потока во времени t .

При движении транспортных потоков на городских улицах и дорогах для определения состояния потока также необходимо знать структуру светофорного цикла, а на магистралях с непрерывным движением — тип пересечения в разных уровнях или наличие поворотов с малыми радиусами, крутые подъемы и тому подобное.

Таким образом, понятие состояния является основным и фундаментальным понятием и формулируется: «Данное состояние транспортного потока в момент времени t_0 и все входные величины (интенсивность или скорость), которые определены для времени t_0 и дальше, полностью определяют поведение транспортного потока при всех $t > t_0$ ».

Будем различать согласно [19; 66] такие виды состояний:

1. Нулевое состояние, которое отвечает отсутствию движения транспортного потока и характеризуется двумя видами:
 - a) пустая дорога;
 - b) затор.

И в том, и в другом случае $N(t) = 0$, $V(t) = 0$.

2. Постоянное состояние транспортного потока, при котором интенсивность в любом сечении и скорость на любом участке дороги остаются неизменными в течение как угодно длительного промежутка времени, то есть

$$\frac{dV}{dt} = 0; \quad \frac{dN}{dt} = 0; \quad \frac{dQ}{dt} = 0 \quad (6)$$

Это постоянный режим движения транспортного потока по улично- дорожной сети при постоянных значениях интенсивности с постоянной скоростью.

3. Состояние равновесия является разновидностью отмеченных выше состояний, когда отсутствуют изменения интенсивности, скорости, дороги и одинаковые управляющие влияния водителей.

Поскольку в реальном транспортном потоке всегда имеют место флуктуации интенсивности и скорости, разные элементы городских улиц и дорог и разные управляющие влияния водителей, то состояние равновесия может быть устойчивым или изменчивым.

4. Периодическое состояние, что наиболее свойственно городскому движению на улично- дорожных сетях с модулируемой длиной перегона и изолированным регулированием. В итоге движение потока периодически останавливается.

Расчеты, связанные с определением транспортного состояния улично-дорожных сетей, будем выполнять с помощью схем замещения, составленных из однотипных идеализирующих элементов (графов связи), которые отображают наиболее характерные свойства элементов сети, независимо от их действительного назначения. Количественная характеристика этих свойств дается числовыми значениями параметров [112].

В схеме замещения любой улично-дорожной сети изображаются все участки и характерные пересечения этой сети, но за внешним видом схема будет заметно отличаться от схемы сети, поскольку в каждом элементе рассмотренной сети могут изменяться условия движения транспортного потока, что требуют соответствующего отображения в схеме замещения.

На рис. 1 представлен пример замещения перегона улицы. Схема замещения может отображать явления в соответствующих элементах реальной сети лишь приблизительно, с той или другой степенью точности. При решении практических задач придется выбирать наиболее простую, но приемлемую схему замещения. Поэтому составление такой схемы будет наиболее ответственной операцией при выполнении расчета. Схема замещения позволяет определить параметры режима для любого элемента сети путем наблюдений и измерений, а также делать моделирование элементов улиц, дорог и сетей. Основными элементами транспортных схем замещения (или просто схем) будут заданы интенсивности, расчетные (разрешенные) скорости автомобилей, плотность потока и его проезжаемость (динамический габарит). Известно, что транспортный поток является сложной системой с ярко выраженной нелинейностью. Однако в данном докладе система «транспортный поток» рассматривается как линейная из таких причин:

во-первых, характеристики транспортного потока имеют линейный характер в определенных областях изменения параметров,

во-вторых, детальное математическое исследование линейных систем достаточно простое, в то время как анализ более общей системы транспортного потока (города, страны) может оказаться

невозможным. Известно, что понятие линейности означает наличие некоторого вида пропорциональности между входными и исходными переменными [19].

Начало движения транспортного потока после включения «зеленого» сигнала совпадает с нулевым состоянием, потому реакция на нулевое входное воздействие (на отсутствие автомобилей) нулевая (скорость потока равняется нулю).

Если входная переменная (интенсивность) нулевая, а реакция системы, отличающаяся от нуля (скорость автомобилей, которые прошли пересечения дороги раньше, не равняется нулю), то эта реакция на нулевое входное влияние является единственно возможной реакцией для данного начального состояния. Аналогично определим реакцию на нулевое состояние, как реакцию транспортного потока на произвольное входное влияние при нулевом начальном состоянии.

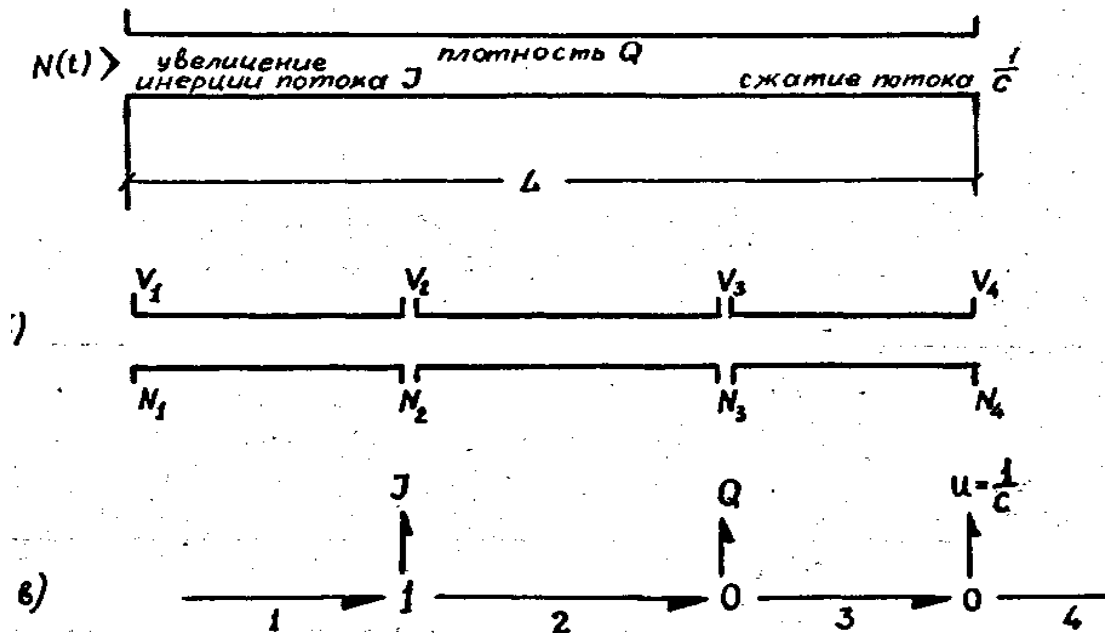


Рис. 1: Представление перегона улицы с одной полосой движения обобщенными параметрами транспортного потока: а) схема перегона с учетом его длины, сжатием потока на выходе (около светофора) и свойствами инерционности; б) схематическое изображение перегона; в) линейный график связей перегона: 1 — узел интенсивности, 0 — узел скорости

Если входная переменная (интенсивность) нулевая, а реакция системы, отличающаяся от нуля (скорость автомобилей, которые прошли пересечения дороги раньше, не равняется нулю), то эта реакция на нулевое входное влияние является единственно возможной реакцией для данного начального состояния.

Аналогично определим реакцию на нулевое состояние, как реакцию транспортного потока на произвольное входное влияние при нулевом начальном состоянии. Уравнениями состояния транспортного потока назовем любую систему уравнений, которая определяет режим его движения.

В более узком значении, уравнение состояния является системой дифференциальных уравнений первого порядка (табл.1), решенной относительно производных.

Метод анализа улично дорожной сети, основанный на составлении и решении систем дифференциальных уравнений первого порядка (уравнений состояния), является методом переменных состояний [66].

Дифференциальные уравнения первого порядка описывают, как установлено раньше, изменения интенсивности и скорости движения транспортного потока на разных участках улично дорожной сети, которые возникают в результате коммутации, то есть выходу или входу части автомобилей потока на перекрестках, примыканиях, подъемах и въездах.

Таблица 1 : Уравнения движения автомобилей и изменении их количества в потоке

N п/п	Уравнения	
	изменение количества потока	движение автомобилей в потоке
1	Общее уравнение	
	$C \frac{d^2\lambda}{dt^2} + \frac{1}{Q} \frac{d\lambda}{dt} + \frac{\lambda}{J} = V(t)$	$J \frac{d^2x}{dt^2} + Q \frac{dx}{dt} + \frac{x}{C} = N(t)$
1.2	$C \frac{dN}{dt} + \frac{N}{Q} + \frac{\lambda}{J} = V(t)$	$J \frac{dV}{dt} + QV + \frac{x}{C} = N(t)$
2	в начале потока	
2.1	$C \frac{d^2\lambda}{dt^2} = V(t)$	$J \frac{d^2x}{dt^2} = N(t)$
2.2	$C \frac{dN}{dt} = V(t)$	$J \frac{dV}{dt} = N(t)$
3	в потоке	
3.1	$C \frac{d^2\lambda}{dt^2} + \frac{\lambda}{J} = V(t)$	$J \frac{d^2x}{dt^2} + \frac{x}{C} = N(t)$
3.2	$C \frac{dN}{dt} + \frac{\lambda}{J} = V(t)$	$J \frac{dV}{dt} + \frac{x}{C} = N(t)$
4	в конце неплотного потока	
4.1	$C \frac{d^2\lambda}{dt^2} + \frac{\lambda}{J} = 0$	$J \frac{d^2x}{dt^2} + \frac{x}{C} = 0$
4.2	$C \frac{dN}{dt} + \frac{\lambda}{J} = 0$	$J \frac{dV}{dt} + \frac{x}{C} = 0$
5	в конце плотного потока	
5.1	$C \frac{d^2\lambda}{dt^2} + \frac{1}{Q} \frac{d\lambda}{dt} + \frac{\lambda}{J} = 0$	$J \frac{d^2x}{dt^2} + Q \frac{dx}{dt} + \frac{x}{C} = 0$
5.2	$C \frac{dN}{dt} + \frac{N}{Q} + \frac{\lambda}{J} = 0$	$J \frac{dV}{dt} + QV + \frac{x}{C} = 0$

На магистралях с регулируемым движением каждый перегон — это проезжая часть, которая состоит из трех элементов: участки, где происходит разгон автомобилей и скапливается инерционность и дорожный потенциал; участки движения автомобилей, где плотность транспортного потока является основным сопротивлением для движения автомобилей; участки торможения и скопления напряженности и транспортного потенциала. На участках с плотностью обычно наблюдается постоянный режим движения транспортного потока, а на участках с разгоном и торможением — переходные режимы, это участки выхода и входа на перекрестках. При переходном режиме движения интенсивность и скорость движения на всех участках улиц и дорог существенно отличается от значения интенсивности и скорости потока при постоянном режиме движения, которое приводит к нарушению нормальной работы автотранспорта и даже к ДТП.

На городских магистралях с регулируемым и нерегулированным движением при разном расстоянии между перекрестками и разными некоординированными циклами включения сигналов светофоров имеет место непериодическое изменение скорости и интенсивности, и потому переходный режим движения автомобилей является одним из основных режимов.

Как уже было показано, значение интенсивности и скорости на любом перегоне улично-дорожной сети, их производные в начальный момент времени t_0 определяются независимыми начальными условиями: скоростью на выходе из перекрестка и интенсивностью на участках входа на перекресток, а также параметрами (транспортными характеристиками геометрических элементов, пропускной способностью и скоростью свободного движения) в момент времени t_0 . Следовательно, любая интенсивность или скорость на городской магистрали при $t > t_0$ может быть найдена по известным начальным данным в момент t_0 известным законам изменения интенсивности и скорости.

Скорость на выходе из перекрестка и интенсивность на входе необходимо рассматривать как основные переменные, что характеризуют состояние транспортного потока, потому что другие переменные зависят от них.

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Design and Performance Evaluation of Solar Water Distillation Plant

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Abstract - Pure water is most essential for human life. But it is not available and rare in most of the place in the world. Pure water is not only important for drinking purpose but also for other issue such as boiler make up or feed water, distilled water for medical uses etc. Hence purifying water is the demand of time. Water purifying is an energy consuming process but our conventional energy resource is limited. In that case alternative renewable energy resources can give us better solution. Solar energy is available resource and gives an optimum solution for this experimental purpose. Designed solar water distillation plant has two parts. Upper part is made by glass and a copper plate for absorbing heat inside it. Proper Insulator is attached behind this arrangement. A small container is linked below it by a small elbow, condensed pure water stored in this container. The lower part is made by cellulite. The cellulite box contain wick. This wick spread from the ground to the backside of copper plate. The wick absorbs the ground water and conveys it up to glass box where this water is evaporated in presence of solar energy. Total system is completely air tight. This plant works quit well but its performance is most depended on wick material. A composite wick material can gives better result.

Keywords : solar energy, solar, water distillation plant.

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Design and Performance Evaluation of Solar Water Distillation Plant

Md. Zargistalukder ^α, Avizitbasak Foisal ^σ, Ahmed Siddique ^ρ & Dr. Mohd. Rafiqulalambeg ^ω

Abstract - Pure water is most essential for human life. But it is not available and rare in most of the place in the world. Pure water is not only important for drinking purpose but also for other issue such as boiler make up or feed water, distilled water for medical uses etc. Hence purifying water is the demand of time. Water purifying is an energy consuming process but our conventional energy resource is limited. In that case alternative renewable energy resources can give us better solution. Solar energy is available resource and gives an optimum solution for this experimental purpose. Designed solar water distillation plant has two parts. Upper part is made by glass and a copper plate for absorbing heat inside it. Proper Insulator is attached behind this arrangement. A small container is linked below it by a small elbow, condensed pure water stored in this container. The lower part is made by cellulite. The cellulite box contain wick. This wick spread from the ground to the backside of copper plate. The wick absorbs the ground water and conveys it up to glass box where this water is evaporated in presence of solar energy. Total system is completely air tight. This plant works quit well but its performance is most depended on wick material. A composite wick material can gives better result. The overall efficiency is satisfactory and can be increase by using more good wick and proper airtight arrangement.

Keywords : solar energy, solar, water distillation plant.

I. INTRODUCTION

Energy is most important fact for modern civilization. Human developments become more accelerate when proper utilization and conversion of energy get more importance. From the very beginning of the world energy is utilized in various ways. So not only development of utilization process but also proper development of conversion process is important. By reducing loss of energy during conversion process, sufficient amount of energy can be saved.

One of the core elements of life is water, which existence increases the probability to found a life. About three-fourth of world are submerged by water but main

question is “how much is useable?” For proper utilization of water some special techniques are required which can purify the water at useable format. With those special techniques energy resource is the basic requirement but limited conventional energy resource through a great challenge during use it. Hence a generic solution becomes the demand of time by which dependency on conventional energy resource is reduced. As a Renewable energy source solar energy can be the best solution. Solar energy can be converted into various smart form of energy, but in this experimental purpose it implemented directly as an energy source.

For analysing purpose a special arrangement have built which have two parts. The upper part is made by glass which contains a copper plate and composite wick material behind this copper plate. A small passage is available to flow condensed water into desired place. The lower part is made by a cellulite which is a cubic box containing wick material. This lower part is attached with upper part and spread to ground. An air tight environment is carefully maintained in this arrangement.

Within this arrangement most important element is wick which acts as an absorber of crude water. Wick material absorbs water from a certain level of depth and hoists it up. Capillarity and surface tension is the most considerable properties during select a wick material. Without it composition of wick material is also important which can develop the absorption properties of wick material. To acquire better performance special composition of wicks is used in this analyzing purpose.

II. RELATED THEORY

a) Solar Energy

Solar Energy is electromagnetic radiation (including infrared, visible and ultraviolet light) released by thermonuclear reactions in the core of the sun. With a few exceptions (e.g., nuclear energy; geothermal energy), solar energy is the source of all ENERGY used by mankind. [1] Indirect forms include hydroelectricity, ocean thermal energy, tidal energy and wind energy; the sun also powers the process of photosynthesis that is the original source of the energy contained in Biomass, Peat, Coal and Petroleum. Usually, however, the term solar energy refers to the portion of the sun's radiant energy harnessed for a specific purpose by man-made devices.

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Solar radiation reaches the Earth's upper atmosphere at a rate of 1366 W/m^2 . While traveling through the atmosphere 6% of the incoming solar radiation reflected and 16% is absorbed resulting in peakir radiance at the equator of $1,020 \text{ W/m}^2$. Average atmospheric conditions (clouds, dust, pollutants) further reduce insolation by 20% through reflection and 3% through absorption. Atmospheric conditions not only reduce the quantity of insolation reaching the earth's surface but also affect the quality of insolation by diffusing incoming light and altering its spectrum.

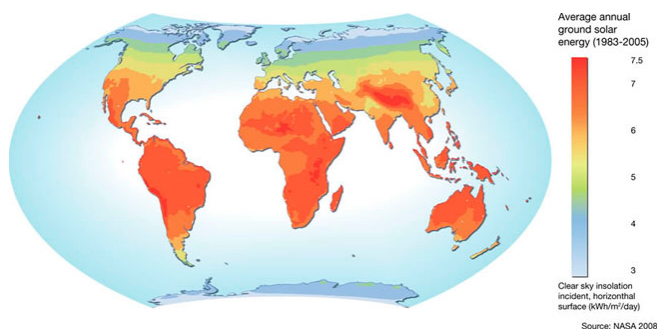


Figure 1 : Map of global solar energy resources. The colors show the average available solar energy on the surface (W/m^2) [3]

The average global irradiance calculated from satellite data collected from recent years. For example, in Bangladesh the average insolation at ground level over an entire year (including nights and periods of cloudy weather) lies between 125 and 375 W/m^2 (3 to $9 \text{ kWh/m}^2/\text{day}$). This represents the available power, and not the delivered power. At present, photovoltaic panels typically convert about 15% of incident sunlight into electricity; therefore, a solar panel in the contiguous Bangladesh on average delivers 19 to 56 W/m^2 or $.45 - 1.35 \text{ kWh/m}^2/\text{day}$. In this point of view direct solar irradiation is utilized in this experimental purpose.

b) Water Circulation

Solar Water Plant is a water cleaning system that cleans water without the use of chemicals, electricity, preventing waterborne diseases, environmental consequences, deforestation, and CO_2 emissions. Water absorbed by wick material then hoist up by means of capillary action of water as in very small tube (capillary tube). Due to solar heating inside the closed glass wick material are heated and hence water evaporate from the wick material. After that the vaporized water condensed at comparatively cool place.

The Capillary action of wick helps to hoist the underground water. Capillary action, capillarity or wicking refers to two phenomena: First the movement of liquids in thin tubes and second the flow of liquids through porous media, such as the flow of water through soil. Capillary action is the result of adhesion and surface tension. The surface tension acts to hold

the surface intact, so instead of just the edges moving upward, the whole liquid surface is dragged upward. The cohesive forces between liquid molecules are responsible for the phenomenon known as surface tension.

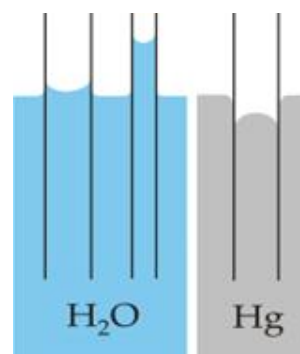


Figure 2 : Capillary action of Water and Mercury

The surface tension of water is 72 dynes/cm at 25°C . It would take a force of 72 dynes to break a surface film of water 1 cm long. The surface tension of water decreases significantly with temperature. The surface tension arises from the polar nature of the water molecule. In hydrology, capillary action describes the attraction of water molecules to soil particles. Capillary action is responsible for moving groundwater from wet areas of the soil to dry areas. Differences in soil potential (Ψ_m) drive capillary action in soil.

c) Selection of wick material

It is very crucial and important to select a wick material. The existing usable wick may not sufficient to fulfill the requirements. Hence it is important to focus on composition of material which having well absorption properties comparative to other regular available wick. Locally available wick having well absorption properties are : Natural fibers such as Cotton or Burlap, Man-made hydrophilic fibers (having a low contact angle with water) such as bare fiberglass, Braided Polyurethane Yarn, Fibrous Rope, Nylon Clothesline, Polyester Rope, Soft Cotton Rope, Nylon Hose, Braided Nylon Rope, Old Polyester Clothing, Pantyhose. To acquire better perform the composition of Cotton and polyester is used in this work.

III. GENERAL CONSIDERATION

The solar water plant consists of a water collectors and solar module that heats, pasteurizes, and decontaminates large amounts of water. The use of chemicals such as chlorine is common practice for disinfecting water supplies in rural communities, which creates adverse environmental issues. Another way of pasteurizing water is heating it, but kerosene is expensive, and in some parts of the world, firewood is becoming scarce.

The basic principles of solar water distillation are simple yet effective, as distillation replicates the way nature makes rain. The solar energy received by solar collector which heats water to the point of evaporation. The evaporated water condensed on the glass surface and then stored in collector. This process removes impurities such as salts and heavy metals as well as eliminates microbiological organisms. It is a passive solar distiller that only needs sunshine to operate. There are no moving parts to wear out. The distilled water does not acquire the "flat" taste of commercially distilled water since the water is not boiled (which lowers pH). It uses natural evaporation and condensation, which is the rainwater process. This allows for natural pH buffering that produces excellent taste as compared to steam distillation. Solar stills can easily provide enough water for family drinking and cooking needs. Solar distillers can be used to effectively remove many impurities ranging from salts to microorganisms and are even used to make drinking water from seawater. [2]

The daily distilled water output (M_e in kg/m² day) is the amount of energy utilized in vaporizing water in the still (Q_e in J/m² day) over the latent heat of vaporization of water (L in J/kg). Solar still efficiency (η) is the amount of energy utilized in vaporizing water in the still over the amount of incident solar energy on the still (Q_t). These can be expressed as:

Solar still production: $M_e = Q_e / L$

Solar still efficiency: $\eta = Q_e / Q_t$

This design can extract water from waterlogged soil, or from salt water, but does not need a body of water such as a stream or lake. This design is suitable where water can lift at a certain height about 5 ft to 7 ft. It produces pure, distilled water from ground water, even if the source is contaminated with inorganic materials such as salt and Pumps water to the surface (through capillary action) and distil it at the same time. It can be made locally with recycled or inexpensive materials in any size and shape. As it has no moving part so as low environmental impact also. After all some constraints are also limited its feature. This system may provide maximum 2-3 litres of distilled water per m² per day. Water processing is depending on solar radiation and so continuous water flow (mass flow rate) is not possible in this process. The evaporating section will need to be cleaned or replaced as mineral salts are deposited there by the evaporating water

IV. DESIGN AND CONSTRUCTION

a) Design Consideration

The first design concept has been taken from the water absorption property of a tree. Tree or plant absorb water from the ground and transpires water particle during respiration. In the tree body water pass cell to cell, the water utilize whole body and remaining leave from the leaf of that tree. Under this consideration,

a complete shape of a body is considered as substitute of the tree. The body is generally air tight. In that body a wicking material are permitted as substitute the tree cell. Then the total system has placed in that place where water source are available. The system placed under the sun ray. So the sun beam incurs on the system and water becomes evaporated. In this time the upper portion of the wick become waterless and water lifted up from the ground due to capillary action. This process is continued with solar energy. After evaporation, the water becomes condensed at comparatively cool place. Then condensed water is collected from the small hole at bellow of the body.

The Basic model of solar water plant is shown in Figure 3. A glass container contains wick. The well shaft (trunk) could extend to a significant length, as it does in a tree. This length could either be used to reach groundwater at some depth below the surface, or to lift the reservoir water above the ground.

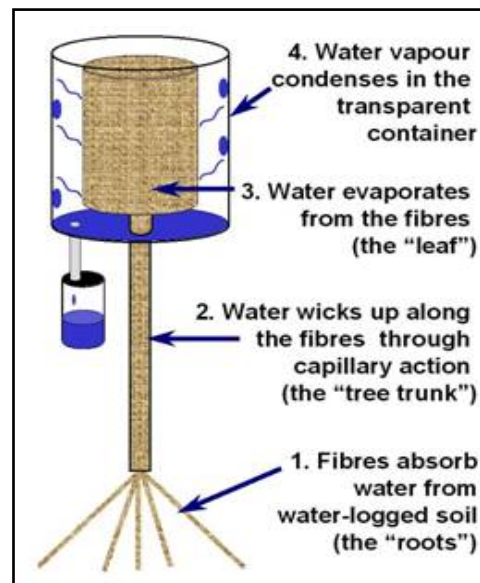


Figure 3 : Model diagram of a solar distillation plant water [4]

Figure 4 is a drawing of a model of the "solar water plant". This cylindrical model was built to show that the principle works, but a flat design is more practical. The advantages of flat design are that condensing water collects on the back of the still instead of the front, and so does not cause solar energy to be lost by reflection. The back of the still should also be cooler, which will help the vapor condense.

b) Experimental Design

The main components of this design included

1. Composition of polyester and cotton as a wick
2. Copper plate
3. Glass box
4. Cellulite
5. Insulated cover

The wick can be made from any material that will absorb and hold water. Materials that work well include: Natural fibres such as cotton or burlap, Man-made hydrophilic fibres (having a low contact angle with water) such as bare fibre glass, Braided Polyurethane Yarn, Fibrous Rope, Nylon Clothesline, Cotton or Polyester Rope, Soft Cotton Rope, Nylon Hose, Braided Nylon Rope, Old Polyester Clothing, Pantyhose. However the composition of cotton and polyester are used in this work.

In this experimental design two main parts are most considerable. Upper part is made by glass so that we can get the opportunity of green house effect in this purpose. The upper part or glass box looks like as upper part as in Figure 4. Within this glass box a copper plate is situated below the glass plate. As copper is a very good heat conductive material, it can transfer heat as uniform fashion. The wicks are attached bellow the copper plate. The lower part is made by cellulite. The wick spread from upper glass box through the cellulite box to the ground water source. The sun raysfall inside the glass box and so on copper plate. In this time the copper plate becomes heated. This hot copper plate heated the wick below the copper plate. Then water inside the wick becomes vaporized and water vapor leaves from the wick.

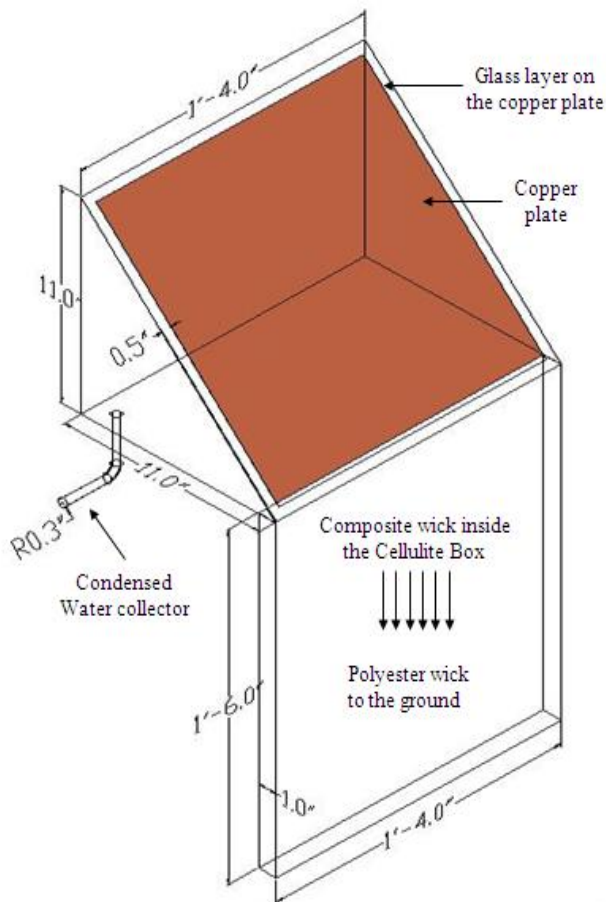


Figure 4 : Experimental Design of solar water distillation plant

Then the vaporized water condensed at comparatively cool place. In the same time water lifted up to fill up the water gap inside the wick. This process has continued during sunny period. The basic principles of solar water distillation are simple yet effective, as distillation replicates the way nature makes rain. The sun's energy heats water to the point of evaporation. As the water evaporates, water vapour rises, condensing on the glass surface for collection (Figure 5). This process removes impurities such as salts and heavy metals as well as eliminates microbiological organisms. The end result is water cleaner than the purest rainwater. The solar still is a passive solar distiller that only needs sunshine to operate. There are no moving parts to wear out.



Figure 5 : Evaporated water condensed on the glass plate

V. PERFORMANCE ANALYSIS

a) Effectiveness of solar water plant

Effectiveness of Solar water distillation plant can be measured by how much it can produce pure water. Generally measurement performed on solar day basis. In this working environment continuous solar energy is available during 8 hours long approximately. So this time span is considered during performance analysis.

Date	Time (hour)	Pure water collection (Liter)	Copper plate area (m ²)	Mass flow rate in each 4 hour (Liter/m ² / 4 hour)	Mass flow rate per day (Liter/m ² /day) (considering a solar day of 8 hour long)
11.05.2010	4	0.150	0.1258	1.192369	2.384738
12.05.2010	4	0.125	0.1258	0.993641	1.987281
13.05.2010	4	0.150	0.1258	1.192369	2.384738
15.05.2010	4	0.135	0.1258	1.073132	2.146264
17.05.2010	4	0.160	0.1258	1.271860	2.543720

Average Effectiveness = 2.289 Liter/m²/day

b) Efficiency of solar water plant

i. Power required for water evaporation

Date	Time T (s)	Mass M (Kg)	Normal temp. $\theta_1^{\circ}\text{C}$	Maximum temp in system $\theta_2^{\circ}\text{C}$	Power consumption $\frac{m * s * \Delta\theta + m * l_v}{t}$ watt
11.05.2010	14400	0.150	37	76	25.33125
12.05.2010	14400	0.125	38	78	21.14583
13.05.2010	14400	0.150	38	75	25.24375
15.05.2010	14400	0.135	36	79	22.95563
17.05.2010	14400	0.160	37	78	27.11333

ii. Efficiency Calculation

Date	Solar intensity I (watt/m ²)	Solar power = (solar intensity $\times$ area) (Watt)	Water evaporating power (Watt)	Efficiency η (%)
11.05.2010	1125	141.525	25.33125	17.90
12.05.2010	1150	144.67	21.14583	14.62
13.05.2010	1100	138.38	25.24375	18.24
15.05.2010	1075	135.235	22.95563	16.98
17.05.2010	1125	141.525	27.11333	19.16

Average Efficiency = 17.38%

VI. CONCLUSION

The effectiveness of this system is 2.289 Liter/m²/day and efficiency is 17.38 % which considered as a satisfactory result but can be improved by better arrangement and using best quality wick. The fiber glass wick is may be best than used composite wick material. This efficiency was obtained under the average solar intensity 1115 W/m². The intensity of sun ray varies with respect to time. Due to reflectivity of solar heat and other losses of solar heating efficiency become comparatively low. The operation of solar water distillation is very simple and no special skill is required for its operation and maintenance. The concept of using the green house solar stills was found to be very attractive method for obtaining the fresh water even for a small-scale demand, because of several economic and technical advantages. The primary setup of solar water distillation

plant is expensive and difficult approach. After all it had constructed easily. To increase sustainability of the system reinforced concrete can be used as a basement and wall of the system. The system must be air tighten precisely so that vapor cannot be get out from the system. As there is no moving part, solar intensity varies with time. To increase its performance automatic tracking system can be used so that the sun rays can incident on the copper plate directly all the day long.

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Power Generation from Sea Wave: An Approach to Create Renewable Energy

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Abstract - This paper presents a brief overview about the design, benefits, risk, and environmental impact of a sea wave power plant. The intention of this accomplishment is to serve society without hampering environmental ecology. This task is based on the renewable sea wave energy. Burning fossil fuel causes global warming. Again wastes of nuclear power plant are very hazardous. Accident of this plant yields great turn of human lives. The power generation from sea wave has growth a huge potentiality. The price of fossil fuel is rising day by day because of its scarcity in nature. As the operating cost of sea wave power plant is low and uses a renewable source of energy, it is possible to produce power at low price. Existing hydrostatic power plant needs dam. This is very harmful for environmental ecology and lives diversity. But this proposed plant does not require any dam or any other hazardous construction and this also reduces the installation cost. However it is reliable, sustainable, environmentally friendly power extraction procedure from sea wave.

Keywords : renewable energy, sprocket system, break-even point, eco friendly.

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Power Generation from Sea Wave: An Approach to Create Renewable Energy

Md. Mahbubur Rahman ^α, Nirupom Paul ^σ, Md. Saiful Islam ^ρ, Md.Safi Rashed ^ω & Shahrior Ahmed [¥]

Abstract - This paper presents a brief overview about the design, benefits, risk, and environmental impact of a sea wave power plant. The intention of this accomplishment is to serve society without hampering environmental ecology. This task is based on the renewable sea wave energy. Burning fossil fuel causes global warming. Again wastes of nuclear power plant are very hazardous. Accident of this plant yields great turn of human lives. The power generation from sea wave has growth a huge potentiality. The price of fossil fuel is rising day by day because of its scarcity in nature. As the operating cost of sea wave power plant is low and uses a renewable source of energy, it is possible to produce power at low price. Existing hydrostatic power plant needs dam. This is very harmful for environmental ecology and lives diversity. But this proposed plant does not require any dam or any other hazardous construction and this also reduces the installation cost. However it is reliable, sustainable, environmentally friendly power extraction procedure from sea wave.

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1. INTRODUCTION

Nowadays the humanity has an energy resources lacking and it try to face it with new renewable energies instead of the old ones which are unsustainable and produce emission of CO₂ and threaten to finish in few years. In this way, we have to consider the oceans like a good source which can provide us an amount of clean and inexhaustible energy. Three fourth of the world's surface is covered by the ocean. Most of the energy that arrives from the sun to the earth is retained by the water of the seas. The oceans are like a very great solar collector. Along this century, several technologies have been researched to get the energy from the sea.

Today there are four types of renewable ocean's energy that are becoming interesting for their good future perspectives.

Wave power refers to the energy of ocean surface waves and the capture of that energy to do useful work. Sea waves are a very promising energy carrier among renewable power sources, since they are able to manifest an enormous amount of energy

able to manifest an enormous amount of energy Resources in almost all geographical regions. The global theoretical energy from waves corresponds to 8x10⁶TWh per year, which are about 100 times the total hydroelectricity generation of the whole planet. To produce this energy using fossil fuels it would result an emission of 2 million tons of CO₂. This means that wave energy could contribute heavily for the attenuation of pollutant gases in the atmosphere, as defended by the Kyoto Protocol [1].

The global wave resource due to wave energy is roughly TW and Europe represents about 320 GW, which is about 16% of the total resource. However, for various reasons, it is estimated that only 10 to 15% can be converted into electrical energy, which is a vast source of energy, able to feed the present all world. Eventually, wave energy could make a major contribution by yielding as much as 120 TWH per year for Europe and perhaps three times that level worldwide. The ocean is a true store of renewable energy. It is believed by some that only about 0.2 percent of the energy in ocean waves could power the entire planet [1].

The main reasons of figuring waves are propel of wind as well as the fluctuation of pressure below the water surface level. Though generating power from wave is not a recently introduced subject at all, very few works have been done using the surface wave of ocean compared to the system of energy generation from storing a huge amount of water and releasing it suddenly. Ocean Trader is a kind of floating object which is partially submerged in the water. This research is also about generating energy by using some submerged objects that are connected to a generator [2].

Ocean waves have two forms of energy (shown in figure 1): the kinetic energy of the water particles (in general follows circular paths) and the potential energy of elevated water particles. The combination of forces due to the gravity, sea surface tension and wind intensity are the main factors of origin of sea waves. Figure 1 illustrates the formation of sea waves by a storm. Wave size is determined by wind speed and fetch (the distance over which the wind excites the waves) and by the depth and topography of the seabed (which can focus or disperse the energy of the waves) [3].

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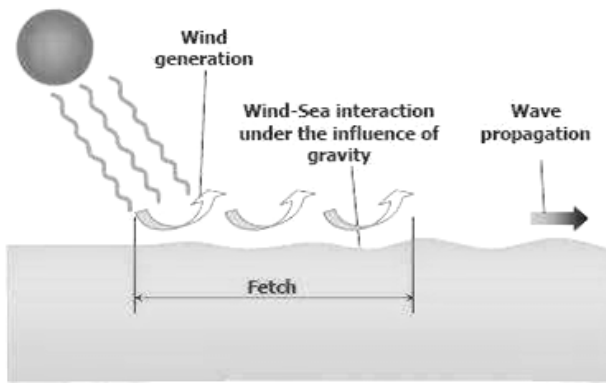


Figure 1 : Typical Sea Wave [3]

The water particles excited by the wind have in each location of the ocean circular trajectories with highest diameter at the surface and diminishing exponentially with depth. The conjugation of this circular motion is responsible for the wave formation and respective propagation, as shown in figure 1. The energy produced by wave depends highly on the following things-

Crest: the uppermost part of the wave

Trough: the lowest point on a wave

Wave length: the horizontal distance between one crest and the next crest (or trough and trough)

Wave height: the vertical distance between a wave's trough and its crest

Frequency: a measure of how many waves pass in a certain amount of time

The frequency of the waves is proportional to the power engendered. On the other hand, the more the waves are generated in a cyclic order the more is the chance of getting sufficient energy [3].

The Ocean can produce two different types of energy: thermal energy from the sun's heat, and mechanical energy from the tides and waves. Ocean Thermal Energy Conversion (OTEC) systems are thought to be very versatile because they have a lot of applications, such as, electricity generation, water desalination, hydrogen production or refrigeration and air-conditioning. On the other hand, both tidal and wave energy can only be used to generate electricity by driving a turbine or generator. Mechanisms of producing ocean mechanical energy are very different from ocean thermal energy. Tidal and waves energy don't need sun heat to be produced, tides are driven by the gravitational pull of the moon, and waves are driven by the winds. That's why, tides and waves energy are intermittent sources of energy, while Ocean Thermal energy is fairly constant. Besides, unlike thermal energy, the electricity conversion of both tidal and wave energy usually involves mechanical devices [4].

Tidal energy is an intermittent source of energy because it only provides power for around ten hours

each day, when the tide is actually moving in or out, in spite of it, tides are totally predictable and it produces electricity reliably. But there are not many places in the world where this technology is efficient. Offshore turbines and vertical-axis turbines are not too expensive to build and neither to maintain because it needs no fuel. Once it is built, tidal power is free. Besides, tidal installations don't produce a large environmental impact and it produces neither greenhouse gases nor other waste. Tidal power turbines provide a higher average power than either wind or wave devices for a given maximum capacity.

Tidal power turbines also have higher duty cycle (50%) than wave turbines (25%). But there is one type of turbine (Shrouded turbine) which may be dangerous to marine life, because fish or marine mammals might get into the turbine blades, through the Venture. Waves generate a clean energy because no fuel is needed and they don't produce any waste. Shore based wave generating equipment is already attracting opposition due to the massive concrete constructions on coastlines which are thought to destroy visual landscape. So appropriate spacing of plants throughout the tropical oceans can nearly eliminate any potential negative impacts of OTEC processes on ocean temperatures and on marine life. Besides, some waves systems can be noisy when waves cross the installation but this can be justified with power generation.

In summary, offshore wind and wave power farms are unpredictable and unreliable energy sources which are subject to extreme weather conditions requiring expensive engineered facilities which have to withstand highly corrosive air/salt-water conditions [5].

For a given area: solar produces kW, wind produces MW and ocean currents produce GW. The oceans cover 71% of the earth's surface with tidal flows and currents on all coastlines as opposed to the limited sites for conventional hydro dams. Based on preliminary surveys the global ocean energy resource is estimated at over 800,000 MW [6].

II. METHODOLOGY

The methodology of sea wave power generation includes Basic design and operation and Output Analysis. Some figures are also included to explain the methodology more clearly.

a) Basic design and operation

The proposed power generation system is not a highly sophisticated process. It includes a number of empty vessels. The empty vessels get up and down randomly due to the upward wave thrust. Each empty vessel is connected to a crank. Cranks are attached with a single shaft. Empty vessel moves up and down. Crank facilitates this linear motion of empty vessel into the rotation of shaft.

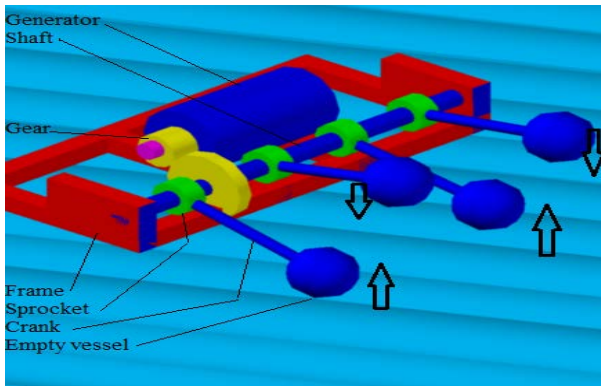


Figure 2 : Schematic view of the power extractive mechanism

There are sprocket system between crank and shaft. The sprocket system promotes only one way rotation of the shaft. At the time of upward movement of empty vessel shaft is engaged with crank, but at the downward movement of empty vessel sprocket system set crank free from shaft. Therefore shaft rotates when an empty vessel rises but the shaft doesn't respond to the downward movement of the vessel. Actually there is the random movement of empty vessel so shaft movement is not uniform. To remove this difficulty a fly wheel is connected to the shaft. Fly wheel give the opportunity to the shaft to rotate uniformly. Vibration may hamper the total structure, but total structure will be made considering vibration. It will be considered the resonance due to sea wave, empty vessel movement, air flow earth quack and what not.

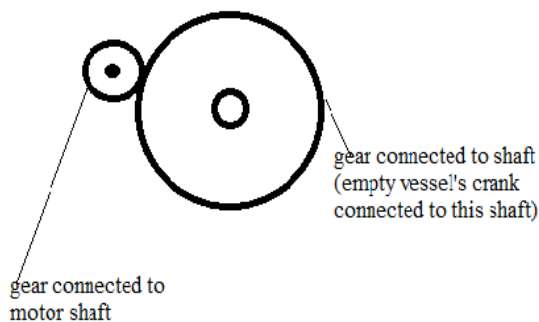


Figure 3 : Gear Train

Gear system is placed between generator and rotating shaft to drive the generator. Another function of this gear system is speed expedition. Main structure is hanged to the sea bed by rope. This structure makes it easy to move vertically to the response of water level variation. This system facilitates horizontal movement of main structure a little bit to the response of tide.

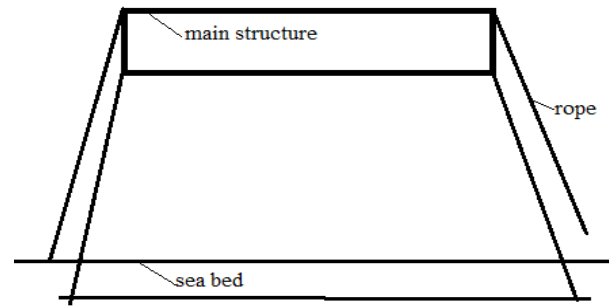


Figure 4 : Total system fixing to the sea bed

Precisely Power transmission from wave to shaft is the conversion of wave energy to mechanical energy. From the shaft power is again transmitted to the generator. At last generator transform mechanical energy to electrical energy. Generator is connected with the bus i.e. the transmission line by submerged cable.

b) Output Analysis

Empty vessels feel upward force which can resist weight of mass,

$$m_f = (v_v \cdot p - m_v) \quad (1)$$

Empty vessel get rise due to upward thrust of water. Then single vessel can make a thrust force,

$$F_{th} = m_f \cdot g \quad (2)$$

The torque on shaft produced by an empty vessel,

$$T = F_{th} \times l_c \quad (3)$$

The shaft gains Energy from the toque produced by empty vessel. This energy for a single empty vessel,

$$E = 2\pi N \quad (4)$$

Therefore due to n vessels, total energy,

$$P = n \times E \quad (5)$$

Energy is transferred from shaft to generator by gear mechanism. If gear efficiency is E_g , Then energy transmitted to generator,

$$P_g = E_g P \quad (6)$$

Generator accepts energy from shaft. Generator is not able to all mechanical energy into electric energy. If generator efficiency is E_m , electrical energy,

$$P_m = E_m P_g \quad (7)$$

Thus the electric energy generation capacity can be calculated using Eq.(7). A hypothetical calculation can be carried out with the following assumption:

A sea wave power plant has 1000 empty vessels which are attached with the main shaft with cranks of length 5 meter. The volume and mass of the vessels are 1 m³ and 200 kg respectively. These empty

vessels make the main shaft rotate at 2 RPM averagely. The gear mechanism has 95% efficiency and the generator has 70% efficiency. With these facilities this plant will be able to produce 325 MW.

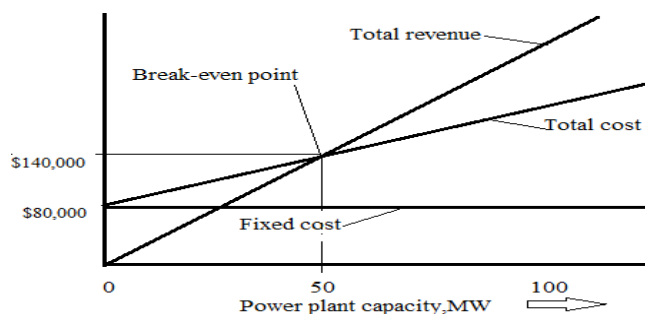


Figure 5 : Estimated Cost-volume analyses

It needs to be realized that what amount of power production will be profitable. For this purpose cost volume analysis has been done. The Fig.5 has shown the relationship among power plant capacity and total revenue, total cost. It has been manifested that when power plant capacity will be more than 50MW, total revenue will surplus the total cost. It is the break-even point. For the purpose of making profit it need to run the power plant at the capacity of more than 50MW.

III. ENVIRONMENTAL IMPACT

The whole world is under the threat of pollution. It includes water pollution, air pollution, soil pollution etc. The existing power plants are largely responsible for these threats. Nuclear power plant has radiation hazardousness. Dam or other structure may cause ecological imbalances. It also causes river pollution and salt pollution to the tropical area. Diesel or coal power plant emit huge amount of CO₂, SO₂ and NO₂.

These causes acid rain and harvest destruction. The emission from diesel and coal power plant is highly responsible for Green House effect i.e. global warming. Dams used in the production of tidal power can raise tide levels. Damages like reduced flushing, winter icing and erosion can change the vegetation of the area and disrupt the balance. Whereas, the sea wave power plant is free from any kind of environmental pollution.

Wave energy is renewable, clean and unpolluted. There is no carbon dioxide or any other by-products released. It doesn't produce greenhouse gases or other waste. As it is renewable, it will help reduce our reliance on the burning of fossil fuels. Wave is always available so it is reliable.

IV. SWOT ANALYSIS

It involves specifying the objective of the proposed power generation process and identifying the internal and external factors that are favorable and unfavorable to achieve that objective.

Strengths: characteristics of the business, or project team that give it an advantage over others

- It is renewable and simple in operation
- Low running cost
- Little maintenance
- Does not hamper water navigation
- Reputation in innovation

Weakness: are characteristics that place the team at a disadvantage relative to others

- New practice
- Funding problem
- Connection to electrical grid is tough

Opportunities: external chances to improve performance (e.g. make greater profits) in the environment are

- Profitable power business
- No emission of gasses
- Environmental friendly
- Favorable distribution and resources
- Support from media and government

Threats: external elements in the environment that could cause trouble for the business or project

- Tsunami, tornado etc. can destroy the power generation system
- Power generation is not constant

V. CONCLUSION

The technology of ocean wave is still juvenile. It has been fairly possible to demonstrate a power generation plan in this paper. It has been manifested that the proposed plan of power generating from wave has some favorable distinct features which makes it possible to be renewable and eco friendly process. Because of the simple design and easy operation it requires low maintenance cost. It requires very few operating cost that makes it the least priced power. Since it is renewable it can be an everlasting process. Its operating cost is incredibly low.

Once you have built it, the energy is free because it comes from the ocean's wave power. It is important to estimate what amount of power generation will make a company profitable. For this purpose cost-volume analysis has been shown (fig. 3). It will attain revenue which will surplus total cost at 50Mw. Therefore, wave power plant can be constructed due to its sustainability, renewability, eco-friendly and friendly to the environment.

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Основи Теорії Функціональних Параметрів І Критеріїв Транспортних Потоків

Ву Професор Гук.В.І

Abstract - Для удосконалення методів проектування вулично-дорожніх мереж, визначення і підвищення пропускної спроможності вулиць і доріг різного класу, ліквідації заторів, розробки методів кількісного і якісного аналізу станів і оптимізації руху насичених транспортних потоків, рекомендацій к удосконаленню державних будівельних норм в напрямку зменшення перехідних режимів руху, як об'єктивної причини виникнення ДТП пропонується узагальнена наукова база, зведена в теорію вимірювачів транспортних потоків. Сформульовані категорійно-понятійний апарат, тезаурус дослідження ґрунтується на таких фундаментальних категоріях як: маса потоку, або його кількість

λ (авт), транспортний час T (с, хв, год), транспортний шлях L (м, км). Потік легкових автомобілів і проїзні частини вулиць і доріг розглядаються як складна система, з'єднана поняттям «транспортний потік», для якого властива зворотна зв'язь, здійснювана водіями і системою управління дорожнім рухом. Основним принципом в теорії, яка розвивається, прийнята цілісність неперервного процесу руху транспортного потоку, т.е. первинним є цілісність потоку, а вторинним — положення і швидкість автомобілів в потоці.

GJRE-J Classification : FOR Code: 091599, 010106

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Основы Теории Функциональных Параметров И Критериев Транспортных Поток

Профессор Гук.В.И

абстрактный - Для усовершенствования методов проектирования улично-дорожных сетей, определения и повышения пропускной способности улиц и дорог разного класса, ликвидации заторов, разработки методов количественного и качественного анализа состояний и оптимизации движения насыщенных транспортных потоков, рекомендаций к усовершенствованию государственных строительных норм в направлении уменьшения переходных режимов движения, как объективной причины возникновения ДТП предлагается обобщенная научная база, сведенная в теорию измерителей транспортных потоков. Сформулирован категориально-понятийный аппарат, тезаурус исследования основывается на таких фундаментальных категориях как: масса потока, или его количество λ (авт), транспортное время T (с, мин, час), транспортный путь L (м, км). Поток легковых автомобилей и проезжие части улиц и дорог рассматриваются как сложная система, соединенная понятием «транспортный поток», которой свойственна обратная связь, осуществляемая водителями и системой управления дорожным движением. Основным принципом

в теории, которая развивается, принята целостность непрерывного процесса движения транспортного потока, т.е. первичным является целостность потока, а вторичным — положение и скорость автомобилей в потоке.

I. Введение

Качественная модель транспортного потока построена на основе фундаментальных физических законов взаимодействия, сохранения и симметрии.

Методической основой разработки обобщенной модели транспортного потока является «теория состояний» потоковых систем и методы энергетического моделирования взаимосвязи между поперечной переменной (интенсивностью $N(t)$) и продольной переменной (скоростью $V(t)$), т. е.

$$\begin{aligned} \text{скорость} &= k_1 \text{ поток;} \\ \text{скорость} &= k_2 \frac{d}{dt} \text{ поток;} \\ \text{скорость} &= k_3 \text{ е поток } dt, \\ \text{поток} &= k_4 \text{ скорость;} \\ \text{поток} &= k_5 \frac{d}{dt} \text{ скорость;} \\ \text{поток} &= k_6 \int \text{ скорость } dt. \end{aligned} \quad (1)$$

Теоретическую базу, которая включает фундаментальные измерители, систему измерителей в абсолютных величинах, систему измерителей в относительных величинах и потенциальные измерители транспортных потоков приведено у табл. 1.

II. Измерители транспорта в абсолютных Величинах

оценивают как отдельные перевозки так и процессы перемещения между отдельными пунктами и

их совокупности. Из трех фундаментальных измерителей: **количество потока** λ (авт), **транспортного пути** L (км) и **транспортного времени** T (год) — образуем для ТП новые производные измерителей, которые имеют произведение степенных функций λ^x, L^y, T^z .

Таблица 1 : Функциональные параметры и переменные ТП

Параметры	единицы измерения	новизна
И. Фундаментальни параметры		
1.1 Количество потока λ	авт.	новое содержание
1.2 Транспортный путь L	км, м	
1.3 Транспортное время T	час, мин, с, сутки, год	
П. Вимириники в абсолютных величинах		
<u>2. Производные по времени t</u>		
2.1 Интенсивность N	авт/ч	авт/ч ²
2.2 Изменение интенсивности dN/dt	авт/ч ²	

автор : доктор технических наук.

2.3	Скорость	V	км/ч	
2.4	Ускорение	$a=dV/dt$	км/ч ²	
<u>3. Производные по пути L</u>				
3.1	Плотность	Q	авт/км	
3.2	Темп движения	$\Theta = T/V$	ч/км	новое содержание
3.3	Удельная интенсивность	$U=N/T$	авт/ч.км	новое содержание
3.4	Удельная плотность	dQ/dx	авт/км ²	новое содержание
3.5	Удельная скорость	dV/dx	км/ч.км 1/ч	новое содержание
<u>4. Производные по количеству потока</u>				
4.1	Динамический габарит	$S=L/\lambda$	км/авт	
4.2	Интервал	$t = T/\lambda$	с	
<u>5. Произведения фундаментальных измерителей</u>				
5.1	Количество движения потока	$D=L \lambda$	авт.км	новое содержание
5.2	Продолжительность движения	$B=T \lambda$	авт.ч	
5.3	Проезжаемость пути	$\Pi=TL$	ч.км	новое содержание
5.4	Мощность потока	$M=NV$	авт.км/ч ²	новое содержание
<u>III. Измерители в относительных величинах</u>				
6.1	Степень заполнения автомобиля		люд. в авто	
6.2	Степень загрузки дороги	$Z=N/N_m$		
6.3	Степень насыщенности движением	$\rho = Q/Q_m$		
6.4	Степень ускорения	$\eta = V/V_o$		
6.5	Уровни удобства движения	A,B,C,D,E,F		
<u>I.V. Потенциальные измерители</u>				
7.1	Дорожный потенциал	$E_o=V \lambda$	авт.км/ч	новое содержание
7.2	Инерционность транспортного потока	J	авт.ч/км	новое содержание
7.3	Быстротечность движения	$B=1/J$	км/авт.ч	новое содержание
7.4	Транспортный потенциал	$E_m=NL$	авт.км/ч	новое содержание
7.5	Напряженность движения	$C=L/N$	км.ч/авт	новое содержание
7.6	Удельная интенсивность	$U=1/C$	авт/ч.км	новое содержание
7.7	Эксергия (внешняя работоспособность)	E	авт.км/ч	новое содержание
7.8	Мощность потока $M=dE/dt=NV$		авт.км/ч ²	новое содержание
7.9	Работоспособность потока H		авт.км/ч	новое содержание

Характеристика транспортного потока, которая определяется отношением транспортного времени T (ч) к транспортному пути L (км), а именно $\Theta = T / L$ (ч/км) есть **темп движения** транспортного потока. В организации движения величина Θ (ч/км) известна как темп движения и применяется для оценки заторовых ситуаций на дорогах. Произведение количества потока λ (авт) на транспортный путь L (км) является транспортным измерителем $D = L \lambda$ (авт.км), известным по единицам измерения как транспортная работа. Однако, данный показатель характеризует только работу двигателя транспортного средства на преодоление пути – это только **количество движения**. Расходы времени на преодоление транспортными средствами или количеством потока λ , умноженные на величину времени пребывания на дороге T , представляют известный транспортный показатель в автомобилечасах, пассажирочасах, грузочасах. Именно $B = \lambda T$ (час. авт) есть **продолжительность движения**. Это характеристика длительности движения потока транспорта, которая очень важна для оценки эффективности транспортной системы. Так же и оценку

уровня аварийности лучше выполнять не на 1 млн. пробега в авт.км, а на единицу пробега за час, даже за сутки. Величины расходов времени на пробег и простой можно подытоживать. Для транспортного потока его быстроту можно определить распределением количества движения λL на скорость потока L/T .

Каждый километр городской улицы или дороги имеет свои планировочные особенности, которые позволяют автомобилю двигаться со скоростью, которая обусловлена правилами и дорожными указателями.

Показатель, который учитывает состояние проезжей части километров улицы и дороги, то есть транспортного пути L , и время, затрачиваемое на преодоление пути, то есть транспортное время T , определяется их произведением, $\Pi = LT$. (км. ч). Это **проезжаемость** транспортного пути.

III. Измерители Транспортного Потока В Относительных Величинах

взаимоуязваны между собой и с транспортными процессами. Загрузка дорог, транспортных узлов, характер условий движения оцениваются отношением

измерителей одинаковых размерностей, то есть относительными величинами.

Измерители транспортного потока, как эксплуатационные показатели, подразделяются на количественные и качественные. Количественные величины характеризуют объем запланированного количества движения, в частности, эффективность использования улиц и дорог, парка легковых автомобилей. Измерители в относительных величинах позволяют делать сравнение во времени, если они поданы в виде его функций с одинаковой размерностью.

Автомобили в транспортном потоке, в зависимости от насыщения, состояния проезжей части, скорости автомобилей, могут двигаться в определенных пределах своих скоростных возможностей. Транспортники США предложили характеризовать определенную комфортность движения в потоке уровнем обслуживания, уровнем имеющегося сервиса (LEVEL service (LOS)). Их шесть: *A, B, C, D, E, F*. Уровни обслуживания *A-E* характеризуют **уровни удобства движения** по отношению к уровню пропускной способности при росте плотности *Q* от нуля до $0,5Q_m$, а уровень *F* – условия насыщенного движения от $0,5Q_m$ к затору при Q_m , потому предлагается еще три уровня *G, H, I*, где при *I* уже затор $Q=Q_m$.

IV. Потенциальные Измерители Транспортного Потока

установлены из учета потенциальной теории пассажирских потоков. Плотность – это сопротивление движения. Показано, что взаимосвязь между скоростью *V* и изменением интенсивности во времени dN/dt определяет **напряженность** *C* в потоке, взаимосвязь между интенсивностью *N* и изменением скорости во времени dV/dt (ускорением) определяет **инерционность** *J* транспортного потока. Плотность, напряженность и инерционность определяют потенциалы системы «транспортный поток – дорога» позволяют составлять уравнение движения транспортного потока в дифференциальной форме. Транспортный поток не может существовать без дороги и его движение обеспечивает соответствующая организация дорожного движения, потому аналогом кинетической энергии является **дорожный потенциал** E_d , потенциальной энергии — **транспортный потенциал** E_m , а **эксергии** – организация дорожного движения $E = E_d + E_m$. Произведение поперечной переменной *N* и продольной переменной *V* указывает на новый измеритель, который обобщает состояние транспортных потоков на разных улицах и дорогах: $NV = M$, где *M* — **мощность** транспортного потока авт.км/ч². Мощность увеличивается как с ростом интенсивности, так и с ростом скорости, которая обеспечивается на дорогах высших категорий и позволяет обосновать целесообразность их строительства. Мощность является производной от

эксергии по времени, $M = dE/dt$. Размерность эксергии *E* (авт.км/ч), которая позволяет учитывать в транспортных расчетах пространственное распределение (*N*).

Дорожный потенциал E_d , транспортный потенциал E_m и **работоспособность** транспортного потока *H* имеют размерность авт.км/ч. Работа транспортного потока – это выполнено за единицу времени перемещение количества потока на единицу пути $H = NL$. Дорога строится для того, чтобы обеспечить автомобилям непрерывное движение с заданной расчетной скоростью в безопасных условиях. Проезжая часть дороги пуста, но обеспечивается возможность для движения. Это и является **дорожным потенциалом** E_d , максимальное значение которого будет при интенсивности, равной нулю, а минимальное — при заторе, когда движение уже не возможно. Дорожный потенциал, как измеритель, определяется произведением количества потока λ на его скорость V ; $E_d = \lambda V$ (авт.км/год). Отношение количества потока λ к его скорости *V*, как продольной переменной потока, определяет новую характеристику — **инерционность** транспортного потока *J*; $J = \lambda / V$ (авт.ч/км), которая указывает на распределение продолжительности движения потока *B* (авт.ч) на пути (км) и подчеркивает, что скорость потока изменяется не мгновенно. Данный измеритель *J* — обязательная составляющая дорожного потенциала: $E_d = 0,5JV^2$.

Величина, обратная по размеру инерционности $B = 1/J$ (км/авт.ч), характеризует скорость движения динамического габарита *S* автомобиля в транспортном потоке и определенная как **быстротечность движения**, быстротечность изменения дорожного потенциала.

На незагруженной дороге, на уровне удобства движения *A* автомобили мчат со скоростью свободного движения. Но их еще мало, с ростом интенсивности скорость уменьшается, но количество автомобилей увеличивается, проходя уровни *B, C, D, E*. При уровне удобства *F* возникает затор. Дорога загружена максимально, в то же время автомобили способны максимальным количеством перевозить пассажиров и грузы, которые в них размещены. Естественно, это транспортный **потенциал** E_t , который определенно произведением интенсивности *N* на путь *L*; $E_t = N L$ (авт.км/ч). Отношение транспортного пути *L* к характеристике поперечного пересечения-интенсивности *N* составляет новый измеритель ТП, $C = L / N$ (км·ч/авт). Это напряженность *C*, или давление, которое возникает в ТП с увеличением количества потока. Это есть изменение продолжительности движения *By* (км.год) среди автомобилей. Это обязательная характеристика транспортного потенциала: $E_t = \dots$. Сума дорожного E_d и транспортного E_t потенциалов определяет **эксергию** ТП (внешнюю работоспособность). $E = E_d + e_t$. Эксергию средствами организации дорожного движения

необходимо поддерживать как постоянную величину, которая характеризует колебательный процесс движения: дорога то пустая (Эд равняется максимальному значению, а ЕТ = 0), то загруженная на уровне затора (ЕТ равняется максимуму, а ЭД = 0). В ТП эксергия это эффект организации дорожного движения на уровне пропускной возможности, то есть общий потенциал системы «дорога – транспортный поток», функционирование которой есть организация движения.

«ИДЕНТИФИКАЦИЯ ТРАНСПОРТНОГО ПОТОКА КАК ОБЪЕКТА УПРАВЛЕНИЯ» рассмотрено состояние и методы ТТП. Научная дисциплина, называемая ТТП, наблюдает реальные явления, связанные с движением потоков транспорта, разрабатывает теории (модели), предназначенные для объяснения данных явлений, использует эти теории для описания того, которое состоится при изменении условий, и проверяет прогнозы новыми наблюдениями. ТТП является высшей формой организации знаний законов движения автомобилей в разных дорожных условиях, при разном уровне управления движением, в разных за составом ТП. Как система знаний о законах движения автомобилей, ТТП имеет ярко выраженную структуру, в которой отображены отношения между автомобилем, дорогой и временами. В формально логическом аспекте — это начальные положения, единицы измерения и сроки теории. Однако фундаментальными понятиями являются не единицы потока времени и длины дороги, а производные от них характеристики: интенсивность N (авт/год), скорость V (пути/год), плотность Q (авт/шлях), которая объясняется недостаточным раскрытием качеств потока. Ядром ТТП является фундаментальное уравнение состояния потока $N=QV(Q)$, уравнения прохождения за лидером $Vn=Vn\alpha(Vn+1 - Vn) /t2$, уравнение динамического габарита в потоке $Ld = V tp + P(top) CV2 + l3 + la$. К фундаментальным понятиям теории принадлежат также законы распределения интервалов между автомобилями и скорости автомобилей.

В исследовании последующее формирование ТТП выполнено в качественном направлении, потому что стохастические зависимости не позволяют открыть связки причинно-наслідкові, закономерности, нелинейность и структуру ТП. Под системой «потек транспорту» визначино совокупность транспортных средств, которые упорядочены согласно правилам и

требованиям безопасности движения и двигаются по одной полосе проезжей части дороги или перегонки городской магистрали. Все элементы, которые не вошли в исследуемую систему, отнесены к окружающей среде. Для описания движения ТП применен аналитический подход, что позволило рассматривать законы движения автомобиля не как изолированного объекта, а как элемента системы или совокупности автомобилей, которые двигаются по одной полосе магистрали и взаимодействуют друг с другом по принципу ведомый и ведущий. Определяется поведение системы как целостной.

Визначино для любой перегонки уравнение алгебраизма, которое связывает скорость потока транспорта V и его интенсивность N . При этом учтена изменчивость скорости и интенсивности во времени. Описание характеристик перегонки будет полным при определении уравнения, которые связывают переменные $V(t)$ и $N(t)$, что в свою очередь характеризуют дуальность (двойственность) транспортной единицы в обобщенных параметрах.

Для определения обобщенных параметров рассмотрено отношение $V(t)$ и $N(t)$, произведение $V(t)$ и $N(t)$ и быстрота изменения одной величины от второй, то есть первые производные за dt . Отношение $N(t)$ и $V(t)$ изучалось многими специалистами. Оно раскрывает плотность Q и динамический габарит S .

Произведение $N(t)$ и $V(t)$ позволил определить **мощность** потока $M(t)=QV^{p(t)}=SN^{p(t)}$.

В первый раз рассмотрено взаимосвязок между $V(t)$ и $dN(t)/dt$, что визначає новую характеристику потока – **обобщенную напряженность** C из уравнения $V(t)=C dN(t)/dt$. Напряженность потока C характеризует быстроту изменения скорости при изменении интенсивности ТП. Установлена зависимость $N(t)$ от $V(t)$ в явном виде. Когда $dN(t)/dt$ существует, то обратное соотношение получим, $N(t)=1/C \int V(t)dt + N(0)$ или $N(t)-N(0)=1/C \int V(t)dt$.

Если $N(t)$ — разрывная функция, то $dN(t)/dt$ не имеет решения. Поэтому проведем замену переменных, введя новую переменную $L(t)$, как обобщен путь. $L(t)=\int V(t)dt$ тогда $L(t)=CN(t)$. Следовательно, закон сжатия (формирование в группу, колонну или увеличение напряженности в ТП на перегонке) можно выразить одной из таких четыре формул:

$$N = \frac{L}{C}, \quad N = \frac{1}{C} \int V dt \quad L = CN, \quad V = C dN/dt \quad (2)$$

которые указывают на накопление потенциальной энергии в потоке. Размерность напряженности $C = L/N$, км. год/авт.

Значительный практический интерес представляет инверсионная напряженность, которая

является скоростью изменения плотности ТП или интенсивностью, которая отнесена к длине дороги $U = 1/C$ это **удельная интенсивность** ТП, размерность какой авт/ч.км.

Взаимосвязь $N(t)$ з $dV(t)/dt$ определим так же аппроксимируя характеристику этой связи при помощи прямой, которую направим через начало координат. Получено уравнение вида $N(t) = J dV(t)/dt$,

где J — передавальна функція інерційності автомобіля для розглянутої системи «ТП». Інтерпретуємо її як **інерційність**, тобто як акумулятор кінетичної енергії (дорожнього потенціалу). У рівнянні інтенсивність $N(t)$ є явною функцією від $dV(t)/dt$. Якщо вона існує в інтервалі $0 \leq T \leq t$, то розв'язання рівняння має вигляд $V(t) = \frac{1}{J} \int_0^t N(t) dt + V(0)$, $V(t) - V(0) = \frac{1}{J}$

$\int_0^t N(t) dt$. Якщо $V(t)$ — розривна функція, то рівняння не має розв'язання. Обійдемо цю складність, використовуючи нову змінну $\lambda(t)$, названу «**кількістю потоку**», що дорівнює $\lambda(t) = J V(t)$. Тоді $N(t) = d\lambda(t)/dt$. Коли інтенсивність є безперервною функцією часу, то кількість потоку $\lambda(t)$ пов'язана з

інтенсивністю $N(t)$ співвідношенням $\lambda(t) = \int_0^t N(t) dt$.

Це рівняння є основним рівнянням кількості потоку і дозволяє вирішувати дві типові задачі:

$$\lambda = JV; N = J \frac{dV}{dt}; V = \frac{\lambda}{J}; \quad (3)$$

Обратная величина инерционности J — это **быстрота изменения расстояния**, или динамического габарита автомобиля. Этот параметр характеризует ускоренность ТП $1/J = B$, единица измерения B —

$$V = N \frac{1}{Q}, V = C \frac{dN}{dt}, V = \frac{1}{J} \int N dt. \quad (4)$$

В свою очередь, зависимость интенсивности от скорости

$$N = QV, N = J \frac{dV}{dt} N = \frac{1}{C} \int V dt. \quad (5)$$

Обоснованно построение уравнений состояний и движения ТП в дифференциальной форме. Для наиболее общей формулировки закона движения ТП как системы материальных тел применен принцип наименьшего действия. Согласно этому принципу ТП характеризуется функцией Лагранжа. Рассмотрено соответствие понятия «эксергия» для системы «ТП». ТП как таковой может существовать только при наличии дороги с полосами движения. При этом будем выделять потенциальные возможности транспорту и потенциальные возможности дороги. Поскольку мощность ТП определяется произведением основных обобщенных параметров состояний: скоростью $V(t)$ и интенсивностью $N(t)$, то уравнение работоспособности

- за известной величиной интенсивности найти закон изменения количества автомобилей в потоке;
- или за известным законом изменения количества автомобилей в группе найти интенсивность.

Фактически элементарная величина интенсивности за время dt равняется изменению количества потока за время тот же dt , то есть $n = d(n)$ (авт.). Это уравнение указывает на закон изменения количества ТП: «Изменение интенсивности ТП за некоторый промежуток времени равняется изменению количества автомобилей в потоке за время тот же». Данный закон позволяет за начальной скоростью автомобилей V_0 и известным количеством потока (интенсивность в интервале времени) находить конечную скорость автомобилей в потоке, минуя все вычисления промежуточных скоростей V .

Числовое значение инерционности можно найти из графической линейной зависимости $\lambda(t)$ от скорости $(t) = \lambda/J V(t)$. Размерность инерционности J — авт.ч/км.

Таким образом, накопление дорожного потенциала ТП на перегонке будет описываться одним из таких уравнений:

км/авт.ч. Показано, что в основных транспортных характеристиках зависимость скорости от интенсивности описывается такими уравнениями

или организации дорожного движения есть. $E = \int N(t)V(t)dt = \int N(t)dL$ Размерность работоспособности — авт.км/ч. Это произведение количества автомобилей в потоке на их скорость движения.

В системе «ТП» возможную, в безопасных пределах, скорость движения автомобилям обеспечивает дорога. Следовательно, построенная дорога имеет большой потенциал, в ней накоплена часть работоспособности. Это дорожный потенциал, который является квадратичной функцией скорости, которая характеризует инерцию в системе «ТП». Учитывая, что произведение инерционности J на скорость V является количеством потока λ , одержимо

$E_d = \int_0^V \lambda dV$ $E_d = \int_0^V \lambda dV$, авт.км/ч. Для обобщенного состояния

$$E_d = \frac{1}{2} JV^2 = \frac{\lambda^2}{2J} \quad (6)$$

Уравнение (6) показывает, что чем с большей скоростью движется ТП, тем выше качество дороги и его потенциал. Дорожный потенциал закладывается категорийными нормативами для каждой дороги и улицы и может быть использован для оценки качества запроектированной и построенной дороги. Во время затора на перегонке находится максимальное количество автомобилей, следовательно будет накапливаться эксергия, противоположная работоспособности дороги и зависящая уже не от скорости, а от координатного положения автомобилей и их количества на перегонке. Эти автомобили имеют большую способность к перевозкам. Следовательно, в системе «ТП» накапливается транспортный потенциал. Одержено уравнения транспортного потенциала

системы «ТП» $E_T = \int_0^L NdL = \int_0^L \frac{1}{C} LdL$ или

$$E_T = \frac{L^2}{2C} = \frac{1}{2} CN^2 \text{ авт.км/ч.} \quad (7)$$

Из уравнения (7) видно, что транспортный потенциал системы равняется нулю при отсутствии автомобилей на перегонке $N = 0$ и максимальному значению — при N_{max} , что равняется пропускной способности пересечения дороги.

Таким образом, на перегонке в системе «ТП» наблюдается замена дорожного и транспортного потенциалов друг на друга. Данное обстоятельство указывает на то, что в такой системе должны возникать колебания, и оптимальные условия движения ТП будут находиться $Ed + ET = E = const$ при некотором постоянном значении работоспособности системы, что обеспечивает организация дорожного движения. Это условие характеризует не только возможность нахождения оптимума функционирования системы «ТП», но и определяет собой закон сохранения работоспособности (эксергии) системы через однородность времени. Величина эксергии $E = const$ остается постоянной во времени. Все виды работоспособности системы «ТП» адитивны, что непосредственно выходит из улично дорожной сети как суммы гонок и суммы потоков, и все виды эксергии будут интегралами движения системы.

Для получения обобщенного уравнения движения ТП учтено, что движение автомобилей происходит в среде потока и дороги, которая оказывает сопротивление, то есть определим функцию рассеивания, или диссипацию эксергии потока.

Доказано: любой автомобиль в ТП имеет двойственность (дуальность), которая оказывается в том, что автомобиль является одновременно источником скорости (движению) и источником интенсивности (потоку), или напряженности в потоке. Автомобиль как единица ТП является источником интенсивности и напряженности и имеет в процессе движения значительные динамические габариты. Участие водителей в транспортном процессе учтено в виде источника неравномерности интервалов между автомобилями в потоке и флуктуации скорости движения.

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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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