IMAGE: A MAP OF THE STARS OF THE ORION CONSTELLATION

Print ISSN: 2631-8474 Online ISSN: 2631-8482

JournalPreview

London Journal of Engineering Research

Volume 20 | Issue 3 | Compilation 1.0

London Journals Press

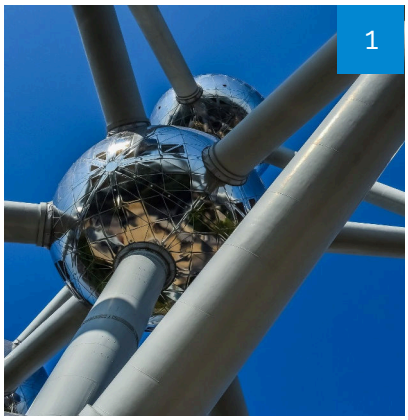
WWW.JOURNALSPRESS.COM

JournalPreview

LONDON JOURNAL ENGINEERING RESEARCH

Journal Content
In this Issue

London Journals Press



Studies of the Interaction of Nucleons in Triplets

Kamliya R.A.

ABSTRACT

Theoretical calculations of the interaction forces of nucleons in triplets containing two neutrons and one proton were carried out. Similar calculations were performed for triplets with one neutron and two protons. The calculations were carried out for various triplet configurations. The most stable states of triplets were found. The mechanism of isomeric transition of the core shown.

Keywords: proton, neutron, electron, interaction, triplet.

Classification: FOR CODE: 030699

Language: English

London Journals Press

LJP Copyright ID: 392932
Print ISSN: 2631-8474
Online ISSN: 2631-8482

London Journal of Engineering Research

Volume 20 | Issue 3 | Compilation 1.0

Studies of the Interaction of Nucleons in Triplets

Исследования взаимодействия нуклонов в триплетах

Kamliya R.A.

Аннотация

Проведены теоретические расчеты сил взаимодействия нуклонов в триплетах, содержащих два нейтрона и один протон. Аналогичные расчеты проведены для триплетов с одним нейтроном и двумя протонами. Расчеты проведены для различных конфигураций триплетов. Найдены наиболее стабильные состояния триплетов. Показан механизм изомерного перехода ядра.

ABSTRACT

Theoretical calculations of the interaction forces of nucleons in triplets containing two neutrons and one proton were carried out. Similar calculations were performed for triplets with one neutron and two protons. The calculations were carried out for various triplet configurations. The most stable states of triplets were found. The mechanism of isomeric transition of the core shown.

Keywords: proton, neutron, electron, interaction, triplet.

Author: Доцент Абхазского государственного университета. Сухум, Абхазия

I.INTRODUCTION

Исследования атомов веществ и их ядер нацелены на выявление факторов определяющих их свойства. Если периодическая система элементов содержит 118 элементов, то количество нуклидов, отличающихся свойствами, равно порядка 3500 [1]. Место в периодической системе занимает элемент с определенным количеством электронов на оболочке, которые распределены по уровням энергии связи с ядром в соответствии с принципом Паули.

Если в ядре атома, занимающее определенное место в периодической системе, содержится другое количество нуклонов при том же количестве электронов, то такой атом называется изотопом. Но бывают нуклиды, имеющие одинаковое количество электронов и одинаковое массовое число, но отличаются по свойствам. Такие элементы называются изомерами.

Если распределение электронов задано принципом Паули, а он един для всех атомов, то остается предположить, что свойства изомеров определяются свойствами ядра – составом и тем как они упакованы. Ядра состоят из синглов, дублетов, триплетов, мультиплетов, упакованных определенным образом и взаимодействующих ядерными силами. В литературе [1] отмечается как факт наличие изомеров, но нет объяснения причин существования изомеров.Объяснений нет потому, что не ясна была природа ядерных сил и почему существуют сильные и слабые взаимодействия.

В работах [2,3] предпринята попытка разгадки природы ядерных сил. Исследования взаимодействия нуклонов ядра является актуальной задачей.

London Journal of Engineering Research

Содержание. Данная работа посвящена исследованиям взаимодействия нуклонов различных вариантов триплетов, которые могут быть ядром атома сверхтяжелого водорода H^3 либо изотопа гелия He^3 .

Триплет – это совокупность трех нуклонов, связанных сильным взаимодействием. Они могут иметь различные структуры.

Каждое ядро H^3 либо He^3 имеет, по крайней мере, один нейтрон и, по крайней мере, один протон. Как было показано в [2,3], на близком расстоянии взаимодействие кварков двух нуклонов, например протона и нейтрона, ориентирует их таким образом, что, в получившемся дублете (рис.1), против каждого заряда одного нуклона расположен противоположный заряд другого нуклона. Черными точками обозначен отрицательный заряд кварка, белыми кружками– положительный. Следует отметить, что при такой взаимной ориентации, силы притяжения всех трех пар зарядов одинаковы.

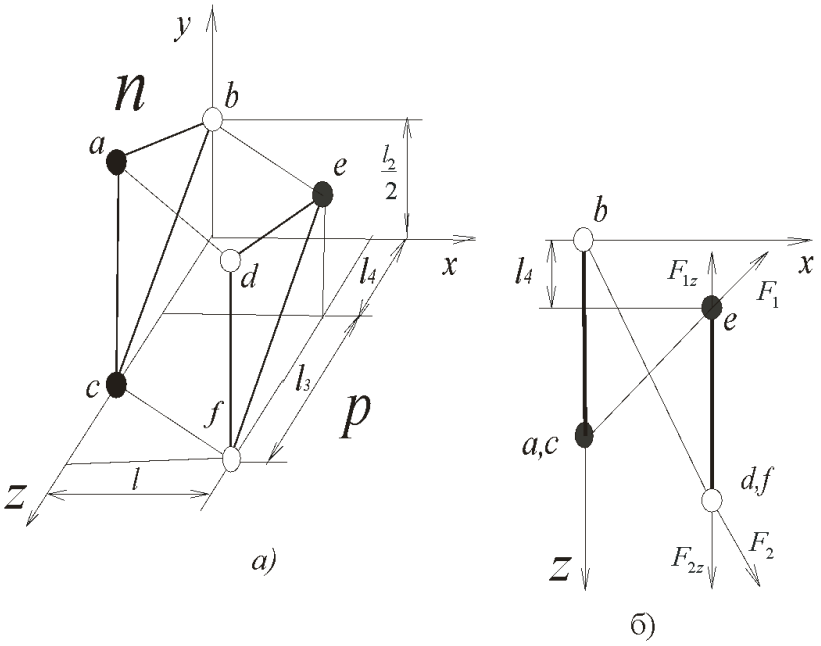


Рис.1.Дублет из нейтрона и протона
а)структура *б*)вид с верху

Однако, следует учесть следующее обстоятельство. Положительные заряды нуклонов имеют заряды +2/3e, а отрицательные - -1/3e. На виде дублета сверху (рис.1*б*) видно, что одноименные заряды расположены по диагонали структуры. Положительные заряды отталкиваются с силой F_2 , большей чем F_1 , с которой кварк *e* отталкивается от кварков *a* и *c*. F_2 – это суперпозиция сил, действующих на кварки *d* и *f*, а F_{1z} и F_{2z} – проекции на ось z сил F_1 и F_2 .Плоскости, в которых лежат кварки нейтрона и протона параллельны, поскольку протон является зеркальным отражением нейтрона с изменением всех зарядов на противоположные знаки. Нет сил, которые нарушили бы параллельность.

Для определенности, мы считаем нейтрон неподвижным, а протон может перемещаться под действием сил взаимодействия. Если сила $F_{2z} > F_{1z}$, то протон будет смещаться по отношению к нейтрону под действием силы F_{2z} - F_{1z}. Существует некоторое значение величины l_4 смещения, при котором F_{2z} и F_{1z} будут равны. Это оптимальное значение зависит и от расстояния l_4 между нуклонами. Для ряда значений l найдены оптимальные значения l_4 (Таблица1). В третьей строке таблицы указаны силы притяжения нуклонов при выбранных расстояниях.

Таблица1

l[Фм]	0.5	0.6	0.7	0.77	0.8	0.9	1.0
*l*4[Фм]	0.1788	0.245	0.304	0.335	0.3545	0.3545	0.438
F[N]	429	258	167	133	115	83	67

Расстояние между плоскостями кварков, на которое могут приблизиться нейтрон и протон с учетом смещения l_4, при диаметре нуклонов D=0.84Фм равно 0.77Фм. В таблице имеется это значение l.

Зависимость силы взаимодействия от расстояния между нуклонами очень резкая. Эта сила зависит от расстояния между зарядами кварков, которая определяется взаимной ориентацией нуклонов. Если диаметр нуклона равен 0,84 Фм, то расстояние между кварками соседних нуклонов может быть значительно меньше этой величины.

Отметим некоторые отправные положения, которых будем придерживаться. Мы полагаем, что кварки находятся на границе нуклонов. Размеры кварков на три порядка меньше размеров нуклонов. Поэтому считаем кварки точечными зарядами. Плоскость, которую можно провести через три кварка, проходит через центр нуклона, считая его сферой.

Теперь, когда сформирован дублет, начнем формировать различные варианты триплетов, присоединяя к дублету с разных сторон нейтрон или протон. Целью является поиск наиболее стабильных триплетов.

Первый вариант такой структуры изображен на рис.2. Как мы уже говорили, взаимодействие зарядов кварков способствует определенной ориентации и расположения нуклонов. Выбранная структура содержит два нейтрона и один протон *p* между нейтронами. Проведены расчеты сил взаимодействия каждого кварка нейтрона a_1, b_1, c_1 с каждым кварком других нуклонов *n* и *p*. Расчеты проводились в системе компьютерной математики Mathcad Prime 3.1. Величины зарядов вносились в программу с учетом знаков. По закону Кулона сила взаимодействия зарядов пропорциональна произведению этих зарядов и поэтому отрицательная сила взаимодействия соответствует притяжению.

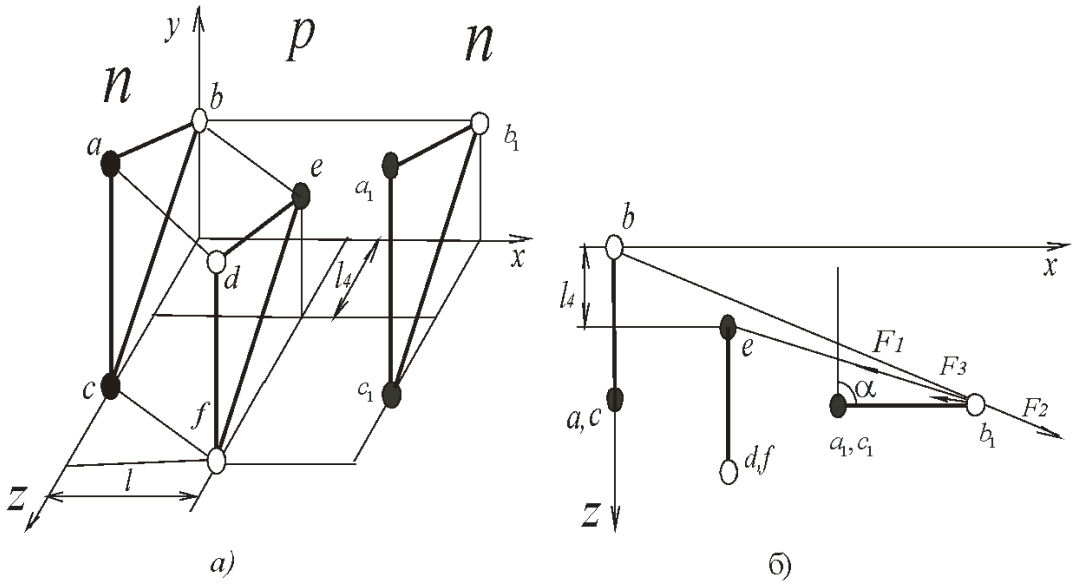


Рис.2. Первый вариант триплета
*а)*структура, *б)*вид сверху

Как следует из расчетов, проекция на ось *x* сил, действующих на кварк b_1 равна $F_{b1} = 26N$, а на кварки a_1 и c_1 действует сила $F_{a1} = F_{c1} = -66N$. Получили, что кварк b_1 отталкивается от дублета, а кварки a_1 и c_1 притягиваются и достаточно сильно. Строго говоря, в структуре, изображенной на рис.2*а*, может отталкиваться любой из кварков b_1,*b*. Однако, если переместится какой то из них, то другой остается притянутым к протону. Мы для определенности полагаем, что перемещается кварк b_1 и при этом уменьшается сила отталкивания кварков *b* и b_1, а кварк *b* остается притянутым к протону.

На какой угол повернется нейтрон $a_1b_1c_1$? Рассчитаем силу, действующую на кварк b_1 при угле α_1 поворота нейтрона 90º (рис.2*б*). Большой ошибки не будет, если будем считать, что кварки a_1 и c_1 остаются неподвижными. Силы, действующие на кварк b_1, равны $F_1 = -20N$, $F_2 = 17N$. Равнодействующая этих сил F_3 направлена против часовой стрелки. Следовательно, угол α, при котором не будет крутящего момента у нейтрона $a_1b_1c_1$ меньше 90º. Точное значение этого угла можно рассчитать, но в данном случае это не принципиально. Если не будет воздействия внешних сил, такое состояние триплета может сохраниться. Заметим, что равнодействующая сил F_3, действующая против часовой стрелки, мала по величине. Поэтому, при воздействии на нейтрон a_1, b_1, c_1 каких то сил, угол α может стать больше чем 90º. Тогда начинают действовать силы притяжения кварка b_1 к кваркам *a* и *c*. Нейтрон начнет вращаться по часовой стрелке и займет положение, показанное на рис.3. Произошел изомерный переход.

London Journal of Engineering Research

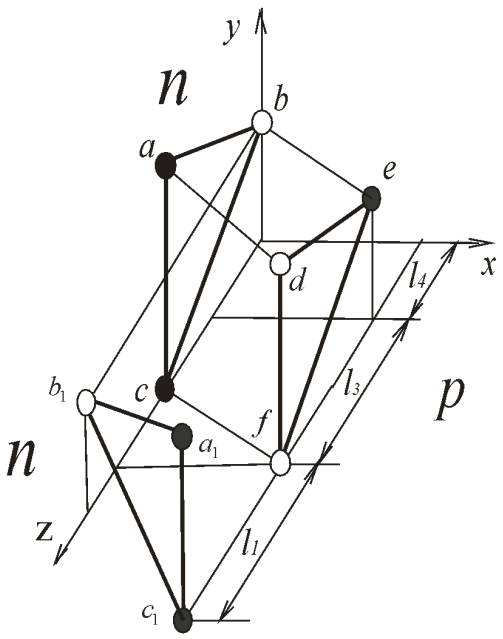


Рис.3. Второй вариант триплета

Проекции на ось z результирующих сил, действующих на кварки a_1, b_1, c_1 при $l_1 = 0.63Фм$ равны: $Fa_1z = Fc_1z = -138N$, $Fb_1z = -63N$. Силы притяжения достаточно большие и действуют на каждый кварк. Такая конфигурация триплета может существовать длительное время.

Теперь рассмотрим конфигурацию, изображенную на рис.4. Расчет сил взаимодействия дублета с нейтроном дают результаты: $F_{a1z} = F_{c1z} = -59N$, $F_{b1z} = 34N$

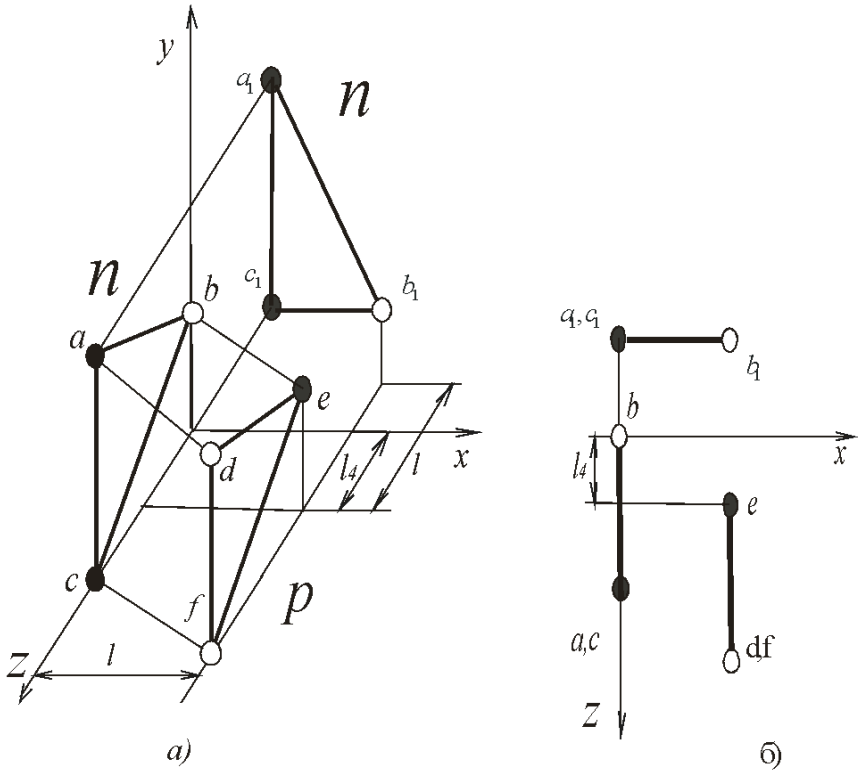


Рис.4. Третий вариант триплета.
а)объемная структура, б)условное обозначение (вид сверху)

Кварк b_1 отталкивается от дублета, а кварки a_1 и c_1 притягиваются с достаточно большой силой. Поскольку сила притяжения кварков a_1 и c_1 значительно больше силы отталкивания кварка b_1, нейтрон поворачивается против часовой стрелки на какой-то угол. Кварки a_1 и c_1 остаются растянутыми к дуплету.

Проведены расчеты сил взаимодействия кварков a_1, b_1, c_1 с дуплетом при угле поворота 90º (Рис.5). При таком угле проекции на ось *x* сил взаимодействия с кварками *a,b,c равны* нулю. Нас интересует проекция на ось *x* силы, действующей на кварк b_1, чтобы определить в какую сторону будет вращаться нейтрон $a_1 b_1 c_1$. Расчеты показали, что сила $F_{b1x} = 1N$ и направлена в отрицательную сторону оси *x*. Следовательно, нейтрон будет вращаться против часовой стрелки. Когда кварк b_1 окажется левее оси *y*, начинают действовать силы притяжения кварков *a,c*. Однако изомерного перехода к структуре (рис.6) не будет. В этой структуре кварк b_1 отталкивается от дублета с силой $F_{b1x} = 20N$ при расстоянии $l_1 = 0.84Фм$. Таким образом, в структуре (рис.5) нейтрон остается притянутым к дуплету с углом поворота больше 90º. При такой

London Journal of Engineering Research

ориентации нейтрона a_1, b_1, c_1 расстояние до кварка *b* может существенно измениться и сила притяжения увеличивается.

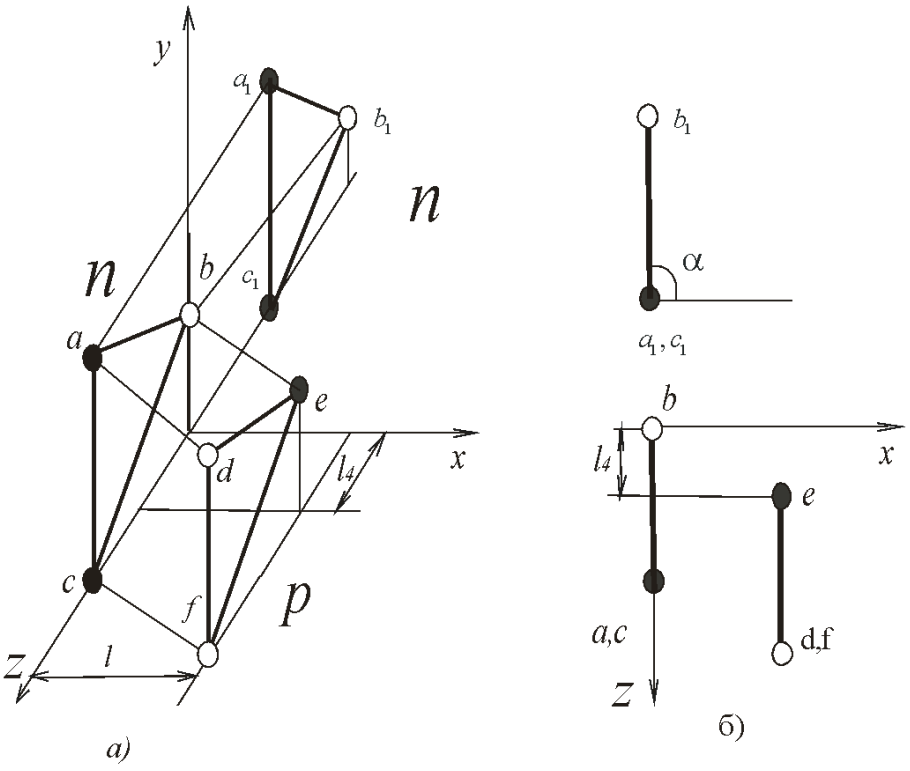


Рис.5. Триплет с развернутым нейтроном
а) структура б)условное обозначение (вид сверху)

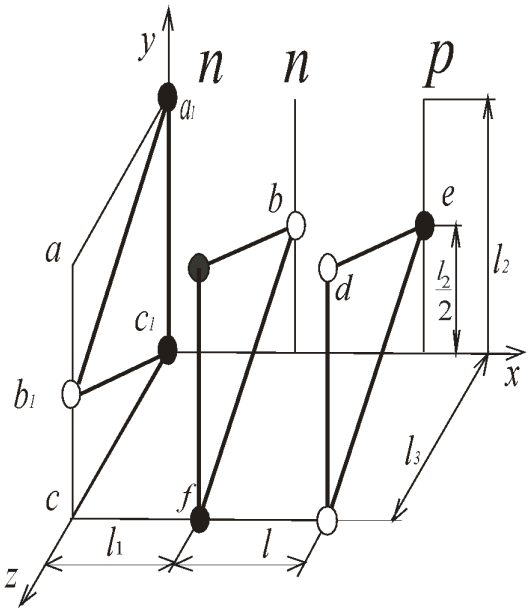


Рис.6. Четвертый вариант триплета

London Journal of Engineering Research

Другую конфигурацию получим, если вместо нейтрона на рис.4 поместим протон с зарядами $q_{a1z} = q_{c1z} = +2/3e$, $q_{b1z} = -1/3e$. В этом случае силы, действующие на кварки a_1, b_1, равны: $F_{a1z} = F_{c1z} = 118N$,

Протон повернется по часовой стрелке на какой-то угол, силы F_{a1z}, F_{c1z} уменьшаются, но даже при оптимальном положении кварка b_1, при которой сила его притяжения к дублету максимальна и равна -30N, сила $F_{a1z} = F_{c1z} = 40N$. Протон отрывается от дублета.

Единственная стабильная структура триплета, содержащая два протона, изображена на рис.7. Расчеты сил взаимодействия протона с дублетом дали следующие результаты:

$F_{a1z} = F_{c1z} = -16N$

$F_{b1z} = -188N$.

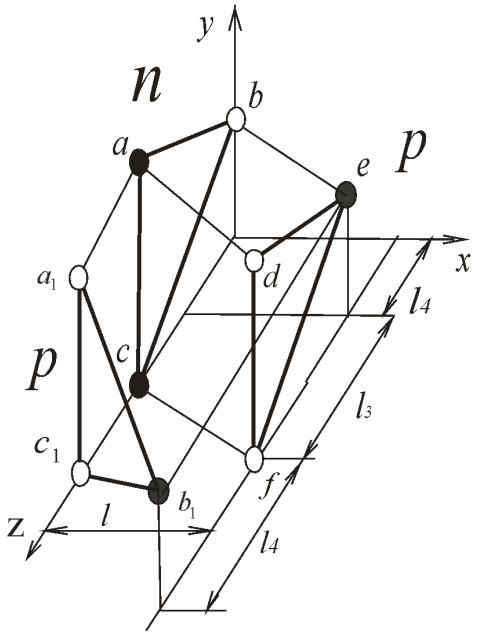


Рис.7. Пятый вариант триплета

Все три кварка притянуты к дублету с достаточно большой силой. Триплет высокостабильный.

Заключение. Как известно, свойства атомов определяются количеством электронов, составом ядра и его структурой. Ядро состоит из синглов, дублетов, триплетов и мультиплетов – это группы

нуклонов связанных сильным взаимодействием. Существуют различные структуры триплетов и мультиплетов, от которых и зависят свойства ядра и атома в целом.

Исследования электрического взаимодействия нуклонов показали, что любая пара нуклонов (нейтрон-нейтрон, нейтрон-протон, протон-протон) образуют дублет с единственным вариантом взаимной ориентации. Если к дуплету добавить еще один нуклон, то количество вариантов структуры триплетов резко возрастает. Количество вариантов упаковки ядра велико для ядер с большим массовым числом, в которых триплеты и мультиплеты, имеющие различные структуры, могут быть еще упакованы различным образом. Именно поэтому существует около 3500 нуклидов при максимальном массовом числе 294 и это наверное не окончательная цифра. Дублеты, триплеты и мультиплеты внутренними силами скреплены сильно, а между собой они взаимодействуют слабее. Этим объясняется в радиоактивных веществах испускание нейтронов и ядер гелия, которые очень стабильны.

Если воздействовать на ядро, например энергичными нейтронами, то внутренние связи могут быть нарушены. Следствием может стать формирования ядра с другой структурой. Поэтому для анализа поведения ядер с большим массовым числом потребуется программное обеспечение, которое будет анализировать процесс формирования ядра, определять структуру сформированного ядра для прогнозирования его свойств.

Литература.

1. Радиоактивность атомных ядер, учебное пособие МГУ имени М.В. Ломоносова под редакцией Б.С. Ишханова, Москва 2017 г.
2. Камлия Р.А. Электросильное взаимодействие, журнал «World Science», №6(46). Vol.1,June 2019.
3. Rasim A. Kamliya Research in Strong Interactions of Protons and Deutrons, Advances in Theoretical & Computational Physics, Volume 2, Issue 4, 2019.

This page is intentionally left blank

Open Shallow Wells Water Qualities Located Around Auto-mechanic Workshops in Some Ilorin Metropolitan Areas

M. A. Adedeji, I. K. Adesina, F.A.Adeniji, & A. O. Chikezie

ABSTRACT

One of the most indispensable resources in the world is water for both animal and plant lives existence. The aim of this research is to ascertain the qualities of water samples collected from nine auto-mechanic workshops located within Ilorin metropolitan areas, in Kwara State. The physiochemical parameters of these samples were analysed and total petroleum hydrocarbon (TPHC) were determined for any possible infiltration of engine oils and other petro- chemical products from these randomly selected workshops into the nearby open wells, using standard methods for the analysis. The physiochemical values of the these samples for South auto-mechanic workshops (SAMW), East auto-mechanic workshops (EAMW) and West auto-mechanic workshops (WAMW) were as follows: for SAMW; pH (6.01 to 6.02), colour (1.01 to 12.20pt-Co), electrical conductivity (EC) (387 to 475µS/cm), turbidity (1.21 to 6.23NTU), total dissolved solids (TDS) (1280 to 1710mg/l), total hardness (TH)(210 to 400mg/l), total iron (TI)(0.05 to 0.26mg/l), copper (Cu) (0.27 to 0.46mgl), manganese (Mn) (0.04 to 0.16mg/l), nitrate (19.52 to 23.40mg/l), Chloride (15 to 40mg/l), (TPHC) (0.001 to 0.012mg/l), chemical oxygen demand (COD)(8.15 to 17.06mg/l), biological oxygen demand (BOD) (10.81 to 14.00mg/l), and for EAMW; (6.71 to 6.87), (0.01 to 0.32pt-Co), (424 to 848 µS/cm), (0.82 to 2.64NTU), (1292 to 1378mg/l), (210 to 410mg/l), (0.10 to 0.79mg/l), (0.27 to 0.71mg/l), (0.13 to 0.28mg/l), (17.40 to 23.81mg/l), (20 to 45mg/l), (0.001 to 0.007mg/l), (8.26 to 13.61mg/l), (8.48 to 14.11mg/l), respectively.

Keywords: open wells, water, quality, analysis, pollution, auto-mechanic and petro-chemical.

Classification: FOR CODE: 090508

Language: English

London Journals Press

LJP Copyright ID: 392933
Print ISSN: 2631-8474
Online ISSN: 2631-8482

London Journal of Engineering Research

Volume 20 | Issue 3 | Compilation 1.0

Open Shallow Wells Water Qualities Located Around Auto-mechanic Workshops in Some Ilorin Metropolitan Areas

M. A. Adedeji[α], I. K. Adesina[σ], F.A. Adeniji[ρ], & A. O. Chikezie[Ø]

ABSTRACT

One of the most indispensable resources in the world is water for both animal and plant lives existence. The aim of this research is to ascertain the qualities of water samples collected from nine auto-mechanic workshops located within Ilorin metropolitan areas, in Kwara State. The physiochemical parameters of these samples were analysed and total petroleum hydrocarbon (TPHC) were determined for any possible infiltration of engine oils and other petro-chemical products from these randomly selected workshops into the nearby open wells, using standard methods for the analysis. The physiochemical values of the these samples for South auto-mechanic workshops (SAMW), East auto-mechanic workshops (EAMW) and West auto-mechanic workshops (WAMW) were as follows: for SAMW; pH (6.01 to 6.02), colour (1.01 to 12.20pt-Co), electrical conductivity (EC) (387 to 475µS/cm), turbidity (1.21 to 6.23NTU), total dissolved solids (TDS) (1280 to 1710mg/l), total hardness (TH)(210 to 400mg/l), total iron (TI)(0.05 to 0.26mg/l), copper (Cu) (0.27 to 0.46mgl), manganese (Mn) (0.04 to 0.16mg/l), nitrate (19.52 to 23.40mg/l), Chloride (15 to 40mg/l), (TPHC) (0.001 to 0.012mg/l), chemical oxygen demand (COD)(8.15 to 17.06mg/l), biological oxygen demand (BOD) (10.81 to 14.00mg/l), and for EAMW; (6.71 to 6.87), (0.01 to 0.32pt-Co), (424 to 848 µS/cm), (0.82 to 2.64NTU), (1292 to 1378mg/l), (210 to 410mg/l), (0.10 to 0.79mg/l), (0.27 to 0.71mg/l), (0.13 to 0.28mg/l), (17.40 to 23.81mg/l), (20 to 45mg/l), (0.001 to 0.007mg/l), (8.26 to 13.61mg/l), (8.48 to 14.11mg/l), respectively. Finally for WAMW; (6.57 to 6.71), (0.41 to 3.11pt-Co), (348 to 549 µS/cm), (0.24 to 4.11NTU), (1239 to 1378mg/l), (210 to 250mg/l), (0.10 to 0.79mg/l), (0.11 to 0.50mg/l), (0.18 to 0.28mg/l), (17.47 to 22.01mg/l),(10 to 25mg/l), (0.003 to 0.012mg/l), (8.15 to 14.21mg/l), (11.22 to 12.42mg/l), respectively. ANOVA results show that the coefficient of determination for each physico-chemical characteristics considered revealed that the Area and Location factors accounted for 51.17%, 62.75% and 38.51%, for BOD, COD and TPHC, respectively, for the wells.

Keyword: open wells, water, quality, analysis, pollution, auto-mechanic and petro-chemical.

Author α: Department of Agricultural and Bio-Environmental Engineering Technology, Federal Polytechnic, Ede, Osun State, Nigeria.

σ: Department of Food and Agricultural Engineering, University Malete, Kwara State, Nigeria.

ρ: Department of Agricultural and Bio- Environmental Engineering Technology, Federal Polytechnic, Nasarawa, Nasarawa State, Nigeria.

I. INTRODUCTION

1.1 Important of Water in Society

Water is one of the most vital natural resources necessary for the existence of life. All life on earth depends on availability of water for their survival, growth and development (Simpi et al., 2011, Chikezie et al., 2018). In most urban cities in various countries such as Nigeria, it is the duty of the government to provide potable water. Despite this realization, a significant amount of contamination already had been released to the nation's soil and groundwater. Scientists have since realized that once an aquifer becomes polluted, it may become unusable for decades. The

major aim of this research is to ascertain the physiochemical and bacteriological qualities of groundwater samples located at or auto-mechanic workshops in Ilorin Municipality, Kwara State.

1.2 Occurrence of Groundwater Pollution

Site-specific characteristics such as soil type, depth of the aquifer, weather, season and the recharge rate of an aquifer all influence the probability and severity of a particular pollution incident. The saturated zone is recharged through the percolation of water through the unsaturated zone. Any contamination that has percolated through the unsaturated zone has the potential to reach the saturated zone, thereby contaminating the groundwater held in the saturated zone. Areas that are replenished at a higher rate are generally more vulnerable to contamination by providing a pathway for the contaminants (EPA, 2003).

1.3 Petroleum Products in Groundwater

Storing liquid petroleum products, such as motor fuel and heating fuel, above ground or underground presents a potential threat to public health and the environment. Nearly one out of every four underground storage tanks in the United States may now be leaking. According to the U.S Environmental Protection Agency, if an underground petroleum tank is more than 20 years old and especially if it is not protected against corrosion, the potential for leaking increases naturally.

II. MATERIALS AND METHODS

2.1 Study Area

Location and size:

The study was conducted within the city three (South, East West) Local Government area of Ilorin, Kwara State. Ilorin is located on latitude 8°24'N and 83°6'N and longitude 4°10'E and 4°36'E. It is situated at a strategic point between the densely populated south-western and the sparsely populated middle belt of Nigeria. Ilorin is located in the transitional zone between the deciduous wood land of the south and dry savannah of North Nigeria (Jimoh, 2003). The choice of Ilorin as the State capital has resulted in its rapid increase in population and urban development. The 2006 population census figure showed that the city had a population of 766,000 (Aderigbe, et al., 2008). Ilorin has grown from what can be describes as "foot city" with residential houses located around the Emir's palace to an 'automobile city' (Aderamo, 2003). The neighboring States and borders by location are, Niger State to the North, Kogi State to the East, Republic of Benin to the West, Oyo and Osun States to the South.

2.2 Surface Drainage and Geological Relief

The state is drained by several river systems. The dominant once are River Moro, Asa, Niger, Weru, Adere, and Oshin. Ilorin consists of Precambrian basement complex rock. The soils of Ilorin are made up of loamy soil with medium and low fertility. Because of the high seasonal rainfall coupled with high temperature, there is tendency for lateritic soil to constitute the major soil types in Ilorin due to the leaching of minerals nutrients of the soil (Ajibade and Ojelola, 2004). The elevation of the area varies from 273m to 333m in the western side with isolated hill (Sobi Hill) of about 394m above the sea level, while on the eastern side it varies from 273m to 364m. The lowest level is along the river valleys of Asa and Oyun while the highest point is Sobi Hill.

Ilorin is mainly drained by Asa River which flows in a South-North direction. The pattern of the drainage system of Ilorin is dendritic. Asa River occupies a fairly wide valley and goes a long way to divide Ilorin into two parts, namely the eastern and the western part. The eastern part covers those areas where the GRA is located while the core indigenous area of Ilorin falls under the western part. Other rivers in Ilorin that drains into Asa River are river Agba, river Alalubosa, river Okun, river Osere, river Aluko, river Yalu, river Odota and river Loma.

2.3 Climate

The climate of Ilorin is characterized by both wet and dry seasons. The rainy season begins towards the end of April and last till October while the dry season begins in November and end in April. The temperature of Ilorin ranges from 33°C to 35°c from November to January while from February to April; the value ranges between 34°c to 37°C. Days are very hot during the dry season. The total annual rainfall in the area ranges from 990.3 mm to 1318 mm. The rainfall in Ilorin city exhibits the double maximal pattern and greater variability both temporarily and spatially. The relative humidity at Ilorin city ranges from 75 % to 88 % from May to October while in the dry season; it ranges from 35 % to 80 % (Ajibade and Ojelola, 2004).

2.4 Vegetation

The derived guinea savanna grasslands dominate the Northern parts of the state while some parts of Southern Ilorin falls within the rain forest agro-ecological zone of Nigeria. Parts of the state especially those surrounding Asa local government is low lying Nigerian basement complex of between 300-400 meters above sea level. In some of the forested savanna areas of the state, a native African savanna tree can be found. The tree is heavily used for the following purposes such as handles for hoes, chewing stick to protect gum decay, etc.

III. MATERIALS

Materials used includes:

- Plastic bottles
- Funnel
- Distilled water
- Cello tape
- Conical flask

IV. METHODS OF ANALYSIS

- Field Investigation
- Laboratory Analysis

4.1 FIELD INVESTIGATION

Each of the sample bottles was rinsed with distilled water and later with a little quantity of the sample. Groundwater samples were collected from wells with the aid of a fetcher and funnels in the different areas of Ilorin metropolis. This was done to be able to ascertain the quality of groundwater located near petrol and diesel stations and effect of possible petroleum leakage on groundwater. The sample bottles were then securely cello taped leaving no space for air. Samples needed for physiochemical parameters were collected in proper labeled plastic bottles. The sample were packed in a cooler provided with ice pack and taken to the laboratory. The water quality test was conducted at a competent laboratory that is authorized by W.H.O (World Health Organization). The parameters that were tested for are giving below. Water samples for physiochemical and bacteriological analysis were collected at point source and nonpoint source and analyzed at the approved laboratory. Samples for bacteriological testing were collected later suitable batches so as to meet the time limit of 48hours between collection and analysis in the laboratory. A geographical positioning system (GPS), German 76 model was used for recording the geographical coordinates of the sampling points of each auto-mechanic garages.

Table 1: Location of control wells within Ilorin metropolitan area

Area	Location	Latitude	Longitude	Altitude
Ilorin South	Maraba Sabo Oke, beside CAC Church	8°48'99"	4°57'10"	268m
Ilorin West	Gari Alimi, behind Total fuel station	8°46'04"	4°50'33"	233m
Ilorin East	Oloje	8°52'31"	4°49'12"	315m

Table 2: Samples Location of Mechanic garages within Ilorin metropolitan area

Area	Locations	Latitude	Longitude	Altitude
Ilorin South	1. Sabo Oke mechanic garage($SAMW_1$) 2. Sango, along Basin mechanic garage ($SAMW_2$) 3. Basin mechanic garage ($SAMW_3$)	8°48'99" 8°51'13" 8°50'93"	4°57'10" 4°59'26" 4°59'34"	271m 276m 289m
Ilorin West	1. Mechanic, Opposite Kwara College of Education, ($WAMW_1$) 2. Mechanic, Opposite NEPA before Sawmill ($WAMW_2$) 3. Mechanic, behind Oando fuel station Gari Alimi ($WAMW_3$)	8°47'44" 8°47'37" 8°46'12"	4°53'07" 4°53'01" 4°52'03"	290m 286m 322m
Ilorin East	1. Mechanic adjacent WAEC office ($EAMW_1$) 2. Mechanic, behind S.A Adeeso & Son fuel station Oloje ($EAMW_2$) 3. Mechanic opposite Federal Government College ($EAMW_3$)	8°52'85" 8°52'51" 8°52'12"	4°49'11" 4°49'37" 4°49'85"	307m 307m 322m

4.2 Laboratory Analysis

4.3 Physicochemical analysis

Physicochemical analysis involves the studies of both physical and chemical properties of the samples. The physical properties are in many cases relatively easy to measure and some may be readily observable by a lay man. Chemical characteristics tend to be specific in nature than the physical parameters and are useful in assessing the properties of samples. The physiochemical parameters studied in this study include:

a) EC
b) Colour
c) pH
d) Taste/Odour
e) Turbidity
f) Total Dissolved Solids
g) Total hardness (Ca Mg)
h) Total Iron
i) Cu
j) Mn
k) Nitrate
l) Chloride
m) TPHC
n) COD
o) BOD

Electrical Conductivity:

HANA Instrument pH/Conductivity meter mode of H198129 (ELE PAQUAQ LAB SYSTEM) was used. The meter was calibrated for EC (Electrical conductivity) using calibration code or solution H2703 (1413 us/cm) for H198129.25ml of the sample was measured into a beaker. After selecting the mode, the measurement was taken when the stability symbol on the screen was display

Turbidity:

When a sample of water is clear but contains suspended matter such as clay silt, finely divided organic matter which gives it a cloudy appearance the water is said to be turbid.

Colour:

Pure water is generally colourless. The presence of organic matter modifies this colour to green, straw, yellow or brown.

Nitrate:

This was done with an instrument know as digital spectrophotometer. 25ml of water sample was filled into the sample cell and nitrate reagent which is in powder from (pillow reagent of nitriver 5 was poured into the 25ml sample). Shake for one (1) minute and was allowed for reaction for five (5) minute (reaction between chemical and water), after that the sample will change light orange colour which show that reaction has taken place. Then the spectrophotometer was programmed to 355 and it wavelength 500NM. Then press clear zero and sample was put into the cell holder box press read/enter, the reading was display on the screen (Hou, et al., 2007).

TH:

This was done with an instrument known as DR/890 data logging colorimeter. The colorimeter was programmed by pressing 30 on the button and enter which display mg/l CaCO3 and zero, 25ml water sample was poured into a sample cell and 1.0 ml of Ca and Mg indicator solution using a 1.0-ml measuring dropper and shake for one (1) minute. Then allowed for five (5) minutes for chemical reaction to take place. 1.0 ml of Alkali solution for Ca and Mg is added into the sample using dropper and shake very well. And one (1) drop of 1MEDTE solution added into another sample cell containing distill water (blank) and swirl to mix, so also 1.0 ml of Ca and Mg indicator was added to the sample prepared and shake several time to mixed. The blank sample was place into the colorimeter holder and covered, zero was press and 0.00mg/l CaCO3 was display then the prepared sample was placed into the cell holder and covered and read was press, then the result was display on the screen in mg/l Mg hardness (as CaCO3). Without removing the cell, program was press and 29 was entered and also press zero and read was entered.

TI:

TI was determined using DR/890 data logging colorimeter, 25ml of the water sample was filled into the sample cell and power pillow reagent of phenanthroline was poured into the sample and was shook vigorously which was allowed to react for three (3) minutes and was placed inside colorimeter cell holder and the result was displayed on the screen.

Mn:

Mn was determined using DR/890 data logging colorimeter. 25ml of the water sample was filled into the sample cell and buffer powder pillow and sodium periodate was poured into the sample with vigorous shaking, and was allowed for three minutes to react and placed into the colorimeter hold and reading was taken.

BOD:

BOD is the measures the dissolved oxygen of the water sample both after it is obtained (initial DO) and after a period of five days (final DO). The amount of oxygen depleted by micro-organisms during the five days incubation period is used to calculate the BOD of the various water samples. Equation 1 gives the parameters to calculate BOD;

$$X_0 + S + O_2 \xrightarrow{N;\ P;\ MN} X_f + T_p + CO_2 + H_2O \qquad (1)$$

Xo: Initial biomass
S: Organic carbon sources
O2: Oxygen
N: Nitrogen source
P: Phosphorus source
MN: mineral nutrients
Xf: Final biomass
Tp: Transformation products of biodegradation
CO2: Carbon (IV) oxide
H2O: Water
Source: Jouanneau, et al., (2014)

COD:

COD measures the oxygen-depletion capacity of the samples contaminants with the hydrocarbon fuels. COD specifically measures the chemically oxidize organic compounds in the samples.

V. RESULTS AND DISCUSSIONS

Physicochemical properties of the open-wells:

The result of the physicochemical properties of each auto-mechanic workshops well water samples collected from WAMW, SAMW and EAMW. That is, three samples each, from three auto-mechanic workshops each, from the three Local Government areas (Simpi, et al., (2011).

PH:

The ph (Fig. 1) values of the water samples recorded for SAMW varied between 6.42 and 6.01 with sample $SAMW_3$ and $SAMW_1$ having the highest and lowest pH values, respectively which complies with the pH values (6.5-8.5) recommended by WHO. While the pH values recorded for EAMW varied between 6.87 and 6.71 with samples $EAMW_2$ and $EAMW_1$ having the highest and lowest pH values, respectively. The pH of the water samples also complied with the values (6.5-8.5) recommended by WHO, and the pH values recorded for WAMW varied between 7.62 and 6.5 7 with sample $WAMW_2$ and $WAMW_3$ having the highest and lowest pH values, respectively, with the pH of the water samples in this location complied with the values (6.5-8.5) recommended by WHO.

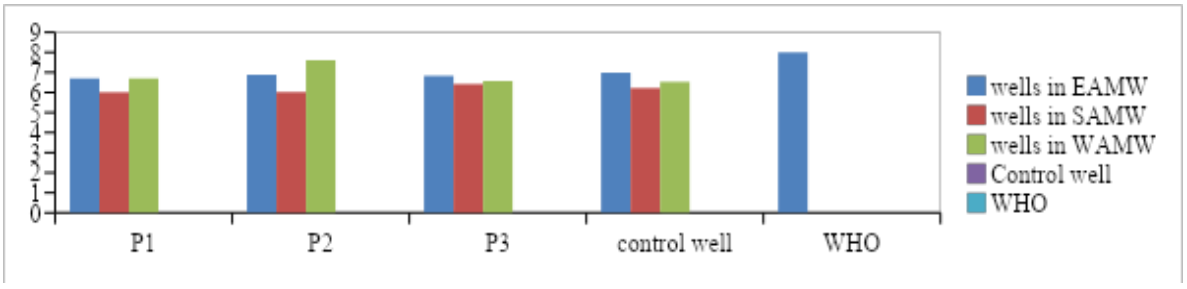


Fig. 1: pH of the samples

The pH of water samples may be as result of type of soil and free carbon (IV) oxide level in the water samples. The fluctuations in optimum pH ranges may result in increase or decrease in the toxicity of poisons in water bodies (Okonkwo et al., 2008).

Colour:

Colour (Fig. 2) of the water samples recorded for SAMW varied between 12.20 and 1. 01 with samples $SAMW_2$ and $SAMW_3$ having the highest and lowest colour values, respectively. Colour values recorded for EAMW varied between 0.32 and 0.01 with sample $EAMW_3$ and $EAMW_1$ having the highest and lowest colour values, respectively. Colour values recorded for WAMW varied between 3.11 and 1.01 with sample $WAMW_3$ and $WAMW_1$ having the highest and lowest colour values, respectively. Colour of the water samples in this location conformed to the values (15pt-Co) recommended by WHO.

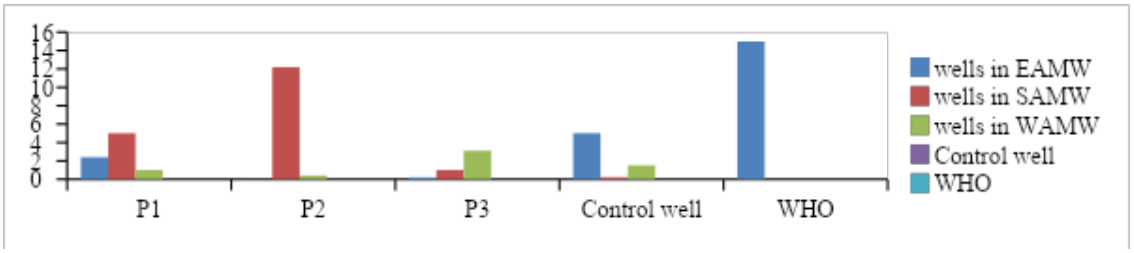


Fig. 2: Colour of the samples

Turbidity:

Turbidity (Fig. 3) of the water samples from SAMW generally varied between 6.23 NTU and 1.21 NTU; sample $SAMW_2$ and $SAMW_1$ having the highest and lowest turbidity level. While the turbidity level of the water samples for EAMW varied between 2.64 NTU and 0.82 NTU; sample $EAMW_1$ and $EAMW_3$ having the highest and lowest turbidity level. Turbidity level of samples for WAMW varied between 4.11 NTU and 0.24 NTU; sample $WAMW_3$ and $WAMW_2$ having the highest and lowest level. Turbidity of the samples for $SAMW_2$ did not comply with standard requirements, it value exceeded the 5.0 NTU recommended by WHO, (2006). This may be due to parental rock activities and surface run off. However, excessive turbidity in drinking water may signify a health hazard.

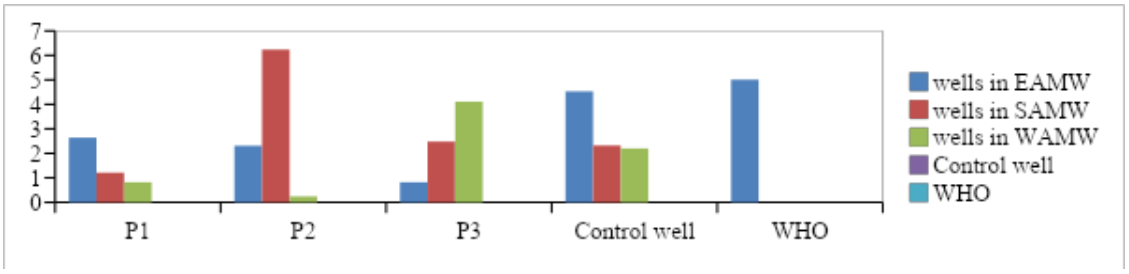


Fig. 3: Turbidity of the samples

EC:

EC (Fig. 4) for SAMW ranged from 475µS/cm and 387µS/cm with $SAMW_2$ and $SAMW_1$ having the highest and lowest values, respectively. EC for EAMW ranged from 848 µS/cm and 424 µS/cm with $EAMW_2$ and $EAMW_3$ having the highest and lowest values. EC for WAMW ranged from 549 µS/cm and 348 µS/cm with samples $EAMW_3$ and $EAMW_2$ having the highest and lowest values.

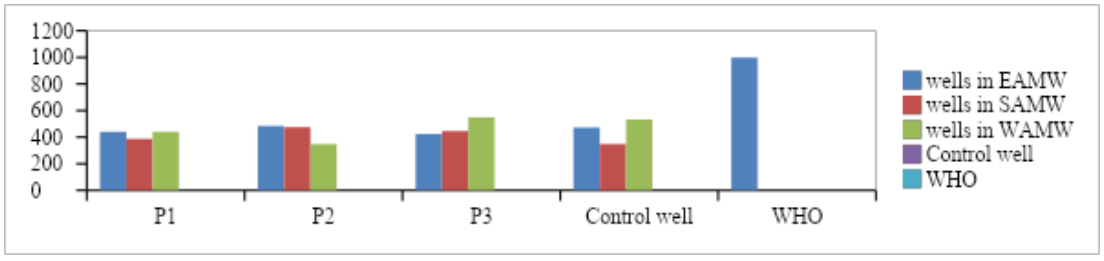


Fig. 4: EC of the samples

TDS:

TDS (Fig. 5) recorded in samples for SAMW varied from 1750 mg/l and 1280 mg/l with sample $SAMW_2$ and $SAMW_1$ having the highest and lowest values, respectively. TDS recorded in samples for EAMW ranging from 1378 mg/l and 1292 mg/l with samples $EAMW_2$ and $EAMW_3$ having the highest and lowest values, values recorded for samples within WAMW varied from 1378 mg/l and 1239 mg/l with samples $WAMW_3$ and $WAMW_2$ having the highest and lowest values. TDS for $SAMW_2$, did not comply with standard requirements, it value exceeded the 1500 mg/l recommended by WHO.

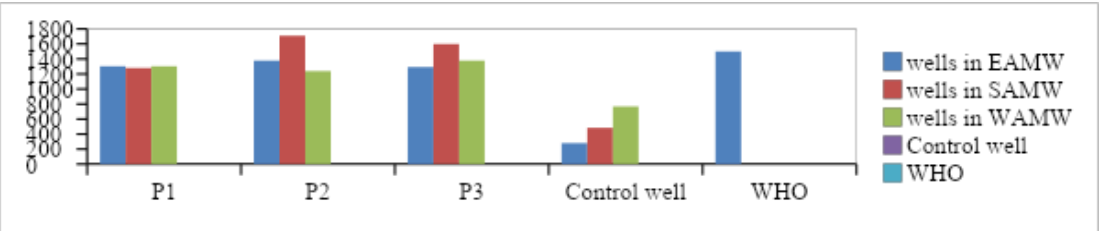


Fig. 5: TDS in the samples

TDS represents the percentage of inorganic substances available in water which reveals the nature of water quality, High TDS gives objectionable odour or offensive taste in water (Aydin, 2007).

TH:

TH (Fig. 6) of 4000mg/l was found in sample $SAMW_3$ while sample $SAMW_2$ recorded the lowest TH of 210 mg/l for SAMW water samples. TH recorded for EAMW ranges from 410 mg/l to 210 mg/l with samples $EAMW_3$ and $EAMW_2$ having the highest and lowest values, respectively. Values recorded for WAMW varied from 250 mg/l to 160 mg/l with samples $WAMW_3$ and $WAMW_2$ having the highest and lowest values, respectively.

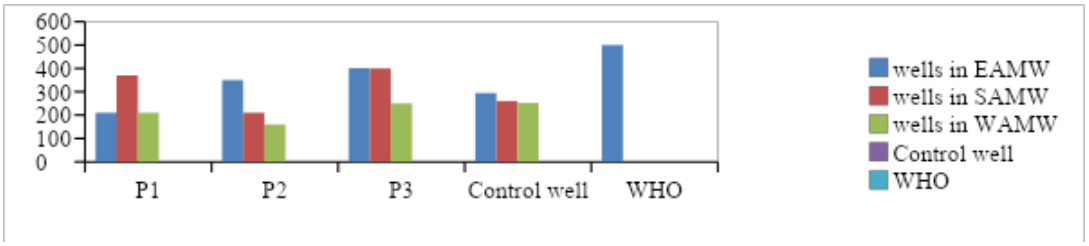


Fig. 6: TH of the samples

TH of the sample $SAMW_1$ is greater than 500 mg/l which does not falls within the maximum permissible limit for drinking water by WHO (2006).

Fe:

Fe (Fig. 7) in SAMW varied between 0.26 mg/l and 0.05 mg/l with sample $SAMW_2$ and $SAMW_1$ having the highest and lowest Iron values, respectively. Values recorded for EAMW varied between 0.79 mg/l to 0.10 mg/l with samples $EAMW_1$ and $EAMW_2$ having the highest and lowest values, respectively. Fe values recorded for WAMW varied between 0.79 and 0.10 with samples $WAMW_1$ and $WAMW_3$ having the highest and lowest values, respectively, Fe content in the samples in this location complied with the values (1mg/l) recommended by WHO.

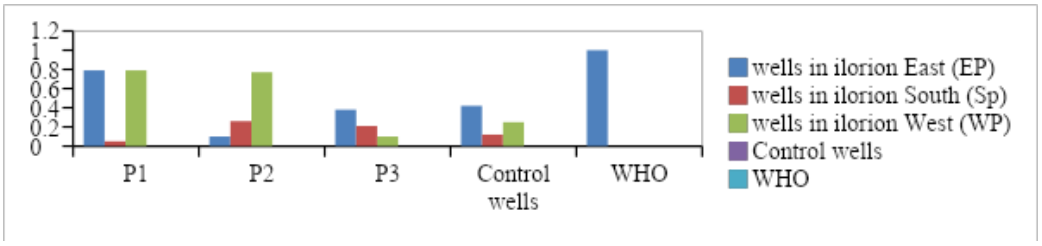


Fig. 7: Iron in the samples

Nitrate:

Nitrate (Fig. 8) in samples recorded for SAMW varied between 23.40 mg/l and 19.52 mg/l with sample $SAMW_1$ and $SAMW_3$ having the highest and lowest values, respectively. Nitrate values recorded for EAMW varied between 23.81 mg/l and 17.40 mg/l with sample $EAMW_3$ and $EAMW_2$ having the highest and lowest values, respectively. Values recorded for WAMW varied between 22.01 mg/l and 17.47 mg/l with sample $WAMW_3$ and $WAMW_1$ having the highest and lowest values, respectively. Nitrate in the samples in this location complied with the values (50 mg/l) recommended by WHO.

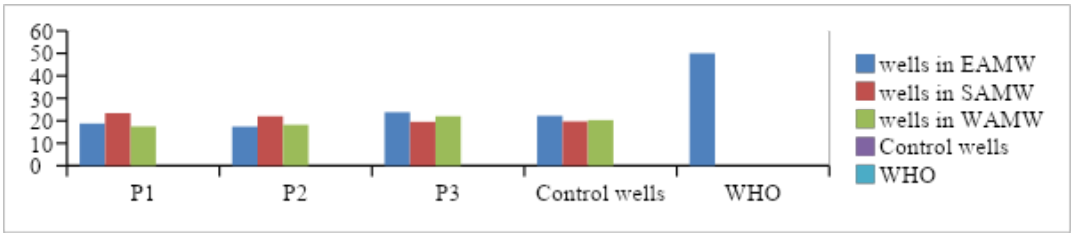


Fig. 8: Nitrate in the samples

Cu:

Cu for SAMW ranges between 0.46 mg/l to 0.27 mg/l with sample $SAMW_2$ and $SAMW_3$ having the highest and lowest value, respectively. Cu content recorded for EAMW varied between 0.71 mg/l and 0.27 mg/l with sample $EAMW_1$ and $EAMW_2$ having the highest and lowest values, respectively. Values recorded for WAMW varied between 0.51 mg/l and 0.11 mg/l with sample $WAMW_2$ and $WAMW_1$ having the highest and lowest values, respectively. Cu values recorded for samples in this location complied with the values (1.5 mg/l) recommended by WHO.

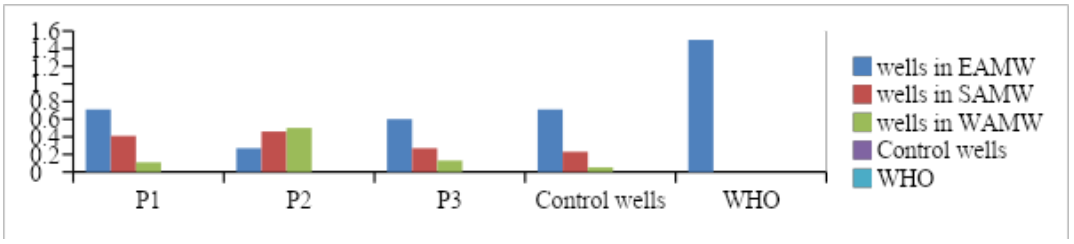


Fig. 9: Cu in the samples

Chloride:

Chloride content in the samples recorded for SAMW ranges between 40 mg/l to 15 mg/l with sample $SAMW_1$ and $SAMW_3$ having the highest and lowest value, respectively. Chloride content recorded for EAMW varied between 45 mg/l and 20 mg/l with samples $EAMW_3$ and $EAMW_2$ having the highest and lowest values, respectively. Chloride values recorded for WAMW varied between 25 mg/l and 10 mg/l with sample $WAMW_1$ and $WAMW_2$ having the highest and lowest values, respectively.

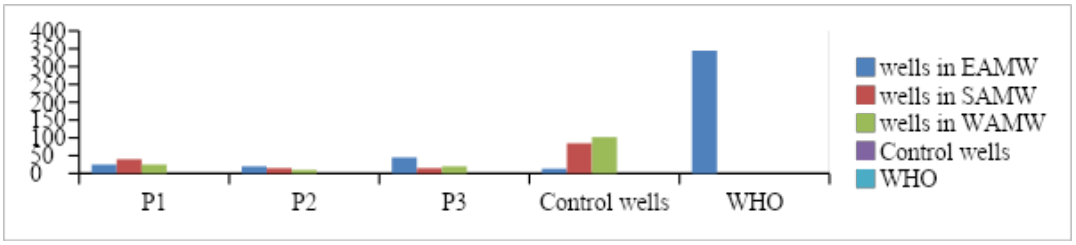


Fig. 10: Chloride in the samples

Chloride present naturally in groundwater and may also originate from diverse sources such as weathering, leaching of sedimentary rocks and infiltration of seawater etc. According to WHO standards concentration of chloride should not exceed 250 mg/L. It produces salty taste at 250mg/L to 500mg/L (MacDonald, 2002). Making it unacceptable for human consumption.

Mn:

Mn of 0.16 mg/l was found in sample $SAMW_2$ while sample $SAMW_1$ recorded the lowest Mn of 0.04 mg/l for SAMW. Mn recorded for EAMW ranges from 0.28 mg/l to 0.13 mg/l with samples $EAMW_2$ and $EAMW_3$ having the highest and lowest values, respectively. Mn recorded for WAMW varied from 0.28mg/l and 0.16mg/l with sample Wp_3 and Wp_2 having the highest and lowest values.

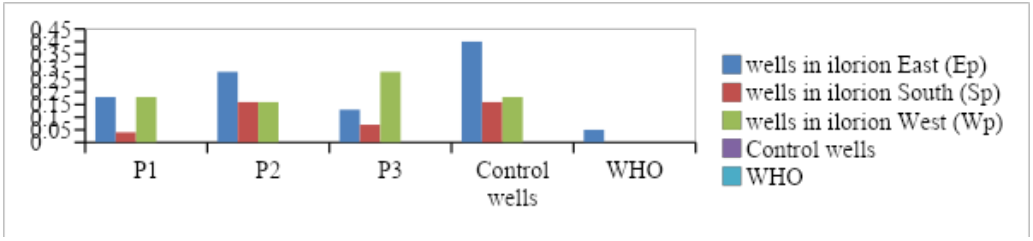


Fig. 11: Mn in the samples

TPHC:

TPHC for SAMW ranges between 0.012 mg/l to 0.001 mg/l with samples $SAMW_1$ and $SAMW_3$ having the highest and lowest values, respectively. TPHC for EAMW varied between 0.007 mg/l and 0.001 mg/l with samples $EAMW_2$ and $EAMW_1$ having the highest and lowest values, respectively. TPHC content for WAMW varied between 0.012 mg/l and 0.003 mg/l with sample $WAMW_3$ and $WAMW_2$ having the highest and lowest values, respectively.

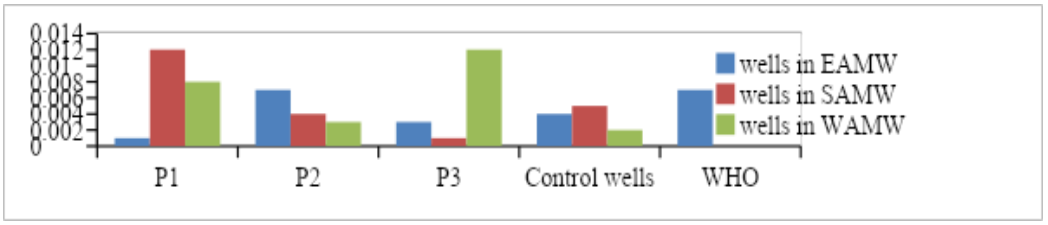


Fig. 12: TPHC in the samples

TPHC values recorded in $WAMW_3$ and $SAMW_1$ water samples does not complied with the values (0.007 mg/l) recommended by WHO. ANOVA (Fig. 13) on TPHC of well water in auto-mechanic workshops within Ilorin Metropolis.

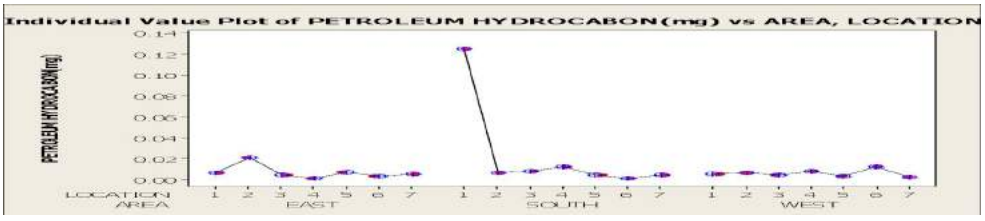


Fig. 13: TPHC base on area and location

COD:

COD recorded for SAMW generally ranged from 17.06 mg/l to 8.15 mg/l, with sample $SAMW_1$ has the highest value and $SAMW_3$ has the lowest value. Values recorded for EAMW ranges from 13.61 mg/l to 8.26 mg/l with sample $EAMW_1$ has the highest value and $EAMW_2$ has the lowest value. COD recoded for WAMW ranges from 14.21 mg/l to 8.15 mg/l with samples $WAMW_2$ having the highest value and $WAMW_1$ has the lowest value. COD of the samples exceeded the maximum permissible limit for drinking water; this could be as a result of the heavy contamination the water sources are exposed to.

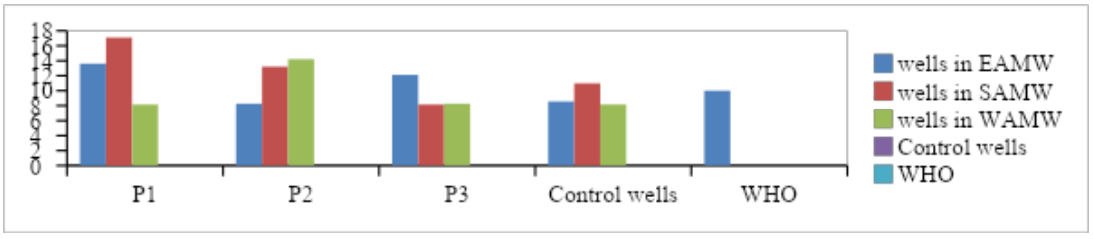


Fig. 14: COD of the samples

ANOVA on COD (Fig. 15) of well water in auto-mechanical workshops within Ilorin Metropolitan area.

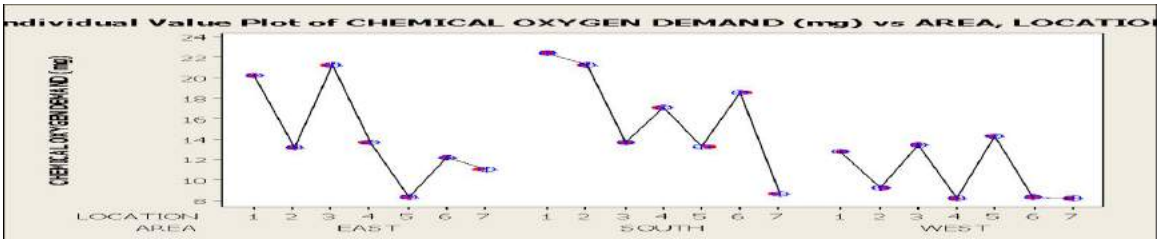


Fig. 15: COD base on area and location

BOD:

BOD for SAMW generally ranged from 14.00 mg/l to 10.31 mg/l with $SAMW_1$ having the highest value and $SAMW_2$ has the lowest value. EAMW ranges from 14.11 mg/l to 8.48 mg/l with $EAMW_1$ having the highest value and $EAMW_3$ has the lowest value. BOD recoded for WAMW ranges from 12.42 mg/l to 11.15 mg/l with sample $WAMW_1$ having the highest value and $WAMW_3$ having the lowest value. BOD of the samples did not comply with the recommended standard value (5.0 mg/l) for drinking water. BOD and COD are used to measure oxygen used and equate it to the amount of organic matter available in the water sample (Clarke *et al.,* 2012). BOD measures the amount of oxygen utilized by microorganisms, in this case, bacterium, to oxidize organic matter available within the water sample (Lv et al., 2002).

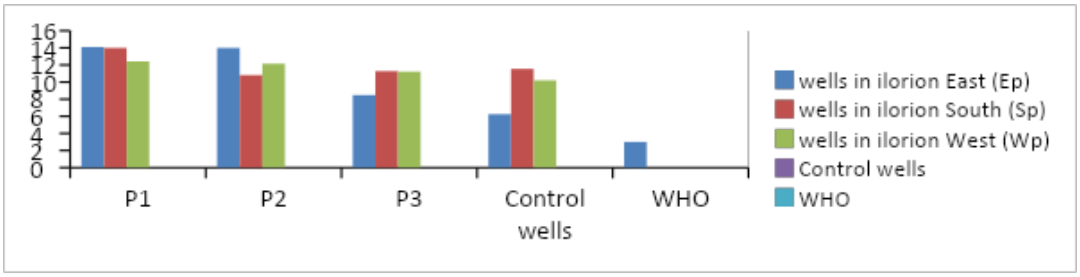


Fig. 16: BOD of the samples

However, ANOVA (Fig. 17) carried out revealed that the coefficient of determination for each physicochemical characteristics considered shows that the factor area and location accounted for 51.17 %, 62.75 % and 38.51 % respectively for BOD, COD and TPHC, respectively of the wells (SAMW, EAMW and WAMW) within Ilorin Metropolitan area. Plates 1-3 show some of wells while Plate 4 illustrates the laboratory equipment.

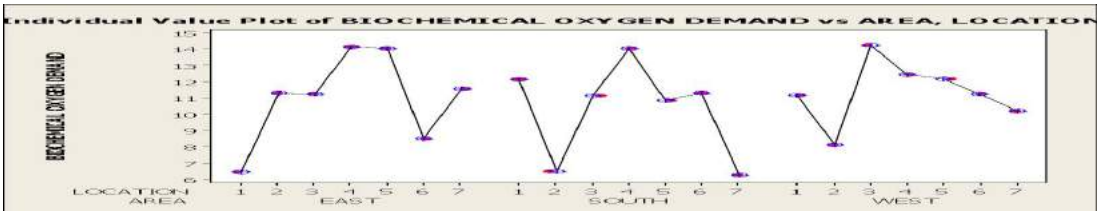


Fig. 17: BOD base on area and location

Plate 1: $SAMW_1$

Plate 2: $WANW_2$

Plate 3: $EAMW_3$

Plate 4: Lab equipment

VI. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The analysis of the water samples from open wells located at auto- mechanical workshops within Ilorin metropolitan area revealed that samples collected from $WAMW_3$ and $SAMW_1$ are polluted with total petroleum hydrocarbon since the level of TPHC in these samples are above the level stipulated by WHO. However, continuous drinks from these wells can lead to accumulation of

petroleum hydrocarbon in the body tissue which may cause adverse effect to human health and petroleum hydrocarbon are known to be carcinogenic in nature.

6.2 Recommendations

a) Due to the presence of contaminants proper treatment or disinfection of the water sources should be carried out before use to reduce the level of contaminants.
b) It is advisable that wells at auto-mechanical workshops should be lined and raised at least 0.508 m (20inch) above the ground level to avoid surface runoff into the well.
c) Sinking of boreholes will solve the problem of the contaminated water particularly for drinking purpose.

REFERENCES

1. A. O, Chikezie, M. A. Adedeji and M. O. Isikwue. (2018). Prediction of soil wetting pattern for three soil types under drip irrigation. EPH - *International Journal of Agriculture and Environmental Research*. Volume-4 | Issue-10 | October, 2018. ISSN: 2208-2158: pp. 1-18.
2. Aderamo A. J. (2003), Changing Structure of intra-urban road network in Ilorin Nigeria (1960-2000). Ilorin Journal of Business and social sciences vol. 8 Nos, 182 pp 65-76 MJT press.
3. Aderibigbe, S. A. Awoyemi, A. O. and Osagbami, G. K. (2008). Availability, adequacy and quality of water supply in Ilorin Metropolis Nigeria. *European Journal of Scientific Research,* 23(4): 528- 536.
4. Agboola, I. (2004). The Diatom (*Bacillariophyta*) Diversity of an Open Access Lagoon in Lagos, Nigeria. *Journal of Research and Review in Science*, 3:70-77.
5. Ajibade L. T, Ojelola A. O. (2004). Effects of Automobile Mechanics Activities on Soil in Ilorin, Nigeria *Geo-Studies Forum an International Journal of environmental and Policy Issues* 2 (1): 18-27.
6. Clarke, E. O. Anetekhai, M. A. Akin-Oriola, G. A. Onanuga, A. I. S. Olarinmoye, O. M. Adeboyejo, O. A., Parihar, S. S., Kumar, A., Gupta, R. N., Pathak, M., Shrivastav, A. and Pandey, A. C. (2012). Physicochemical and microbiological analysis of underground water in Gwalior city, mp, India. *Research Journal of Recent Science*, 1(6): 62-65.
7. EPA, (2003). Environmental Protection Agency, Safe Drinking Water Act. EPA 816-F-03 016.
8. Hou ZA, Li PF, Gong J, Wang YN (2007). Effect of different soil salinity levels and application rates of nitrogen on the growth of cotton under drip irrigation. Chinese J Soil Sci 38: 681-686 (in Chinese with an English abstract).
9. Jimoh, H. I. (2003). Erosion Tolerance Range of Landuse Surface: Implication on Land Resource Use and Management Techniques in Ilorin, Nigeria, *International Journal on Environmental Studies,* 60 (5): 445-452.
10. Kayode J, Oyedeji A. A, Olowoyo, O. (2009). "Evaluation of the effect of pollution with spent lubricant oil on the physical and chemical properties of soil". Pacific J. Sci. Tech. 10 (1):387-391.
11. Lv DQ, Wang QJ, Wang WY, Shao MA (2002) Salt distribution and effect factors in under-film drip irrigation. J Irrig Drain 20: 28-31 (in Chinese with an English abstract)
12. Okonkwo, I. O, Adejoye, O. D, Ogunnusi, T. A, Fajobi, E. A. and Shittu, O. B. (2008). Microbiological and physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos State, Nigeria. *African Journal of Biotechnology,* 7(5):617-62.
13. S. Jouanneau, L. Recoules, M.J. Durand, A. Boukabache, V. Picot, Y. Primault, A. Lakel, M. Sengelin, B. Barillon, G. Thouand. (2014). Methods for assessing biochemical oxygen demand (BOD): A review. www.sciencedirect.com Journal homepage: www.elsevier.com/locate/watres water research 49 (2014) 62-8 2.

14. Simpi, S. M, Hiremath, K. N. S., Murthy, K. N., Chandrashekarappa, A. N. and Patel, E. T. (2011). Analysis of water quality using physicochemical parameters Hosahalli Tank in Shimoga District, Karnataka, India. *Global Journal of Science Frontier Research*, 1(3): 31-34.
15. WHO (2003). Polynuclear aromatic hydrocarbons in drinking water. Background document for preparation of WHO Guidelines for drinking water quality. Geneva. World Health Organization (WHO/SDE/WSH/03.04/59).
16. WHO (2009) *Calcium and magnesium in drinking-water: public health significance*. Geneva, WorldHealthOrganizationhttp://whqlibdoc.who.int/publications/2009/9789241563550eng.pdf
17. WHO. (2000). Global Water Supply and Sanitation Assessment 2000 Report. United Nations, New York.

Combinatorial Optimization and Refinery Operations Resource Solutions Reachability at the Location

C. R. Mallick, S. K. Parhi & L.N Das

Delhi Technological University

ABSTRACT

In applied mathematics literature, "Combinatorial Optimization" is a topic that consists of finding an optimal object from a finite set of objects. VRP meaning, vehicle routing problem combined with TSP, or traveling salesman problem, and MSP minimum spanning tree problems are some of the examples of Combinatorial Optimization topics. This topic further complicates while vehicle route and terminal junctions are assigned with certain constraints.

The paper also contains an example concerning the mathematical model of a routed ship engine carrying crude/refined oil vessel ship from a reservoir port to download at several destination petroleum refinery port reservoirs, and the ship operation schedule is based on the multistage decision-making process. The Indian oil petroleum refinery processors use the petrochemical solutions carried with the proper vessel ship shuttles from abroad crude petroleum exploring oil wells, uploaded at abroad seaport oil reservoir, and dispatched to Indian refinery locality seaports within definite sea routes periodically, in time inventory schedules.

Keywords: combinatorial optimization, vehicle routing problem, multi-stage decision-making.

Classification: FOR CODE: 861199

Language: English

London Journals Press

LJP Copyright ID: 392934
Print ISSN: 2631-8474
Online ISSN: 2631-8482

London Journal of Engineering Research

Volume 20 | Issue 3 | Compilation 1.0

Combinatorial Optimization and Refinery Operations Resource Solutions Reachability at the Location

C. R. Mallick[α], S. K. Parhi[σ] & L.N Das[ρ]

ABSTRACT

In applied mathematics literature, "Combinatorial Optimization" is a topic that consists of finding an optimal object from a finite set of objects. VRP meaning, vehicle routing problem combined with TSP, or traveling salesman problem, and MSP minimum spanning tree problems are some of the examples of Combinatorial Optimization topics. This topic further complicates while vehicle route and terminal junctions are assigned with certain constraints.

The paper also contains an example concerning the mathematical model of a routed ship engine carrying crude/refined oil vessel ship from a reservoir port to download at several destination petroleum refinery port reservoirs, and the ship operation schedule is based on the multistage decision-making process. The Indian oil petroleum refinery processors use the petrochemical solutions carried with the proper vessel ship shuttles from abroad crude petroleum exploring oil wells, uploaded at abroad seaport oil reservoir, and dispatched to Indian refinery locality seaports within definite sea routes periodically, in time inventory schedules.

The routed ship carried crude/refined oil vessel download at several Indian Seaport is compared to a multistage decision-making model for uniform distribution of energy resource solutions considering the operational resource material needs. The algorithm for solving the problem is a specific combinatorial optimization problem-solving technique, which is focused on the paper.

Keywords: combinatorial optimization, vehicle routing problem, multi-stage decision-making.

*Author*α: Asst Professor Parala Maharaj College of Engineering, Berhampur, Odisha, India.
σ: Assistant Professor, Fakir Mohan University, Vyasa Vihar, Baleshwar, Odisha, India.
ρ: Professor, Delhi Technological University, Delhi, India.

I. INTRODUCTION

More or less the specific Operational resource problems namely Assignment problem, shunt closure problem, constraint satisfaction problem [1], cutting stock problem[1], technician scheduling problem, travelling salesman problem [1], vehicle rescheduling problem [1], vehicle routing problem and security protection combined problems [2] are indirectly solving by the renewable energy serving agencies while they are procuring the energy resource material.

1.1 Genetic Algorithm for ship Routing and scheduling problem with time window

TSP and VRPTW are examples of genetic algorithms. The TSP or traveling salesman problem (may be TSP meaning Transit signal process) based on a salesman who must visit n clients and return to the initial place of departure. The objective is to visit all clients without passing the ones previously visited. The VRPTW or vehicle routing problem with the time window (or may be Virtual record process time window), is a

generalization of TSP where the clients request either delivery or pickup of a cargo amount. The VRP differs from TSP is the fact that more than one vehicle is needed to deliver the cargoes with the associated costs. Linear shipping, marine inventory routing and optimal speed, are some of the constraints to the virtual record process time window for a Transit signal process. However, (I) capital depreciation costs relating to the loss of a ship cargo's market value with respect to initial investment, (II) costs for ship and cargo maintenance, insurance, crew salaries (III) day-to-day operation costs such as fuel consumption, port and customs expense, tolls paid at canals etc. are the constraints to Vehicle routing Problem and Travelling salesman problem.

The Vehicle Routing problem can be assumed as Vessel fleet routing through sea routes to the seaports of petroleum crude/refined petrochemical storage locality. The combinatorial problem "What is the optimal set of routes for a fleet of vehicles to traverse in order to deliver cargo to a given set of customers?" is a research topic. By the way, the problem generalizes travelling salesman problem. One of the objectives of the VRP is to minimize the total route cost.

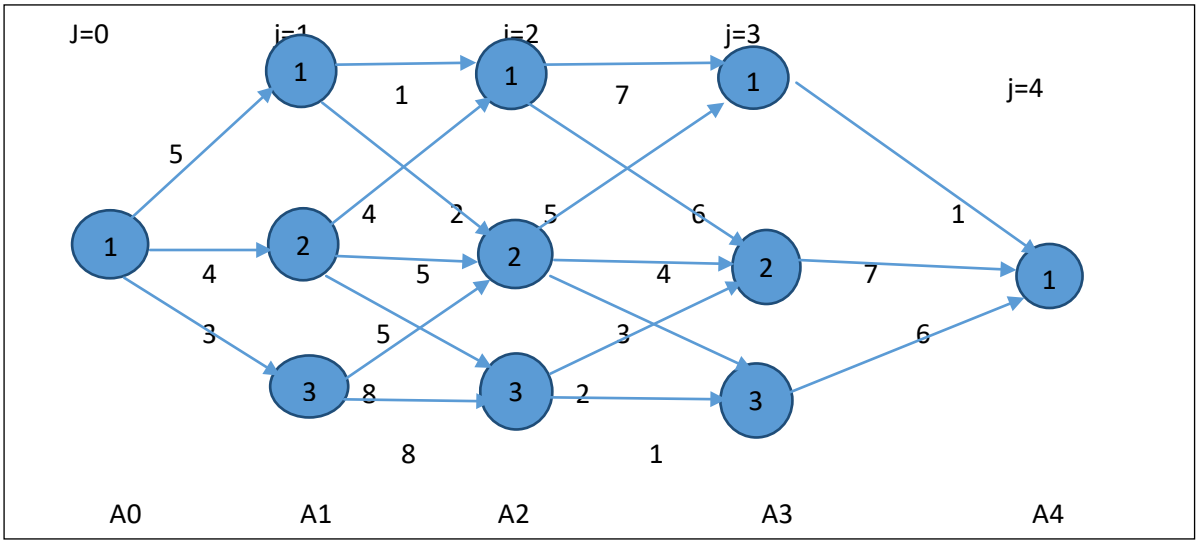
The network supports vessel routing can be represented paths from the vertex A_0 to the vertex A_n along directed arcs joining the effective vertices in the intermediary stages representing indexes $j = 1, 2, \ldots, (n-1)$. Each intermediary stage has at most $n-2$ states or vertices. Thus the vehicle routes through the vertices in the n stages. For convenience, we denote subscript j is the index of node vertices and edge arcs. The initial stage $j = 0$ is attached to stage $j = 1$ which has $n-2$ states of vertices and sequentially connects the final stage $j = n$ with arc links.

On each move the vessel routes from stage j to stage $j+1$. In the way vessel passes any one vertex in stage j to one vertex in stage $j+1$. The possible alternative paths from one stage to the next stage are decided by comparing the arc variable values w_j.

The assignment problem is one of the combinatorial optimization problems. In reference to the VehicleRouting problem the route set assignments can be modified for assigning a number of fleets to specific seaports routes and it is similar to the assigning number of tasks to a number of agents. If the number of seaports equal to the number of fleet vessels, any sea port storage facility is greater or equal to contained material of fleet vessels, the concerned seaport can be assigned to specific fleet vessels. Assignment cost optimality is decided with the application of Hungarian algorithm [3].

II. MULTISTAGE LEAST COST PATH DETERMINING MODEL

The Petrochemical oil refinery seaports in India are Koyali, Mumbai, Mangalore, Kochi, Chennai, Tatipaka, Vizag, Paradip, and Haldia. These port authorities and oil companies (list is enclosed in the Appendix -B) import crude or refined petroleum through fleet vessels transport systems. The second routing problem consists with the container train assignment from seaports to distant refineries in India. The list of refinery companies and location map location name refinery capacity are mentioned in the web. But this list does not contain all the planned petrochemical storage locations in India.



The seaport authority India planned to establish a refined oil storage at seaport Dhamara location 60km east to Paradip. In the above network graph we assume the nodes represent the formal location of the seaports. The arcs are transition paths connecting node to node. The number levels to arc consists of costs in lakhs. The problem is to select a sequence of nodes in such a way that minimize the costs

There are nine seaports in India having facilities for Crude/refined petroleum storage. The above graph has five stages of nodes. Excluding the starting node the remaining nodes represent more than one seaport for material transactions. From the graph w_4 is the variable weight assigned to stage four or A4 and can have numeric values $w_4 = 1$ or 7 or 6. Then the prior nodes are $x_3 = 1$, 2 or 3.

$$Thus\ F_4(x_4) = F_4(1) = \left[1 + F_3(1),\ 7 + F_3(2),\ 6 + F_3(3)\right];\ = [w_4 + F_3(x_3)]$$

Where $F_3(x_3)$ has three possible options, $F_3(1)$, $F_3(2)$ and $F_3(3)$, depending on the values of w_4. Moreover, $F_3(1) = [7 + F_2(1),\ 5 + F_2(2)]$

$$F_3(2) = [6 + F_2(1),\ 4 + F_2(2),\ 2 + F_2(3)]$$

$$F_3(3) = [3 + F_2(2),\ 1 + F_2(3)$$

The above expressions can be written in the form $F_3(x_3) = [w_3 + F_2(x_2)]$

The three values of $F_3(x_3)$ are calculated with possible values of w_3 and possible values of $F_2(x_2)$ depending on w_3.

In a similar manner particular values of $F_2(1)$, $F_2(2)$, $F_2(3)$ can be calculated with the following relations.

$$F_2(1) = [1 + F_1(1),\ 4 + F_1(2)]$$

$$F_2(2) = [2 + F_1(1),\ 5 + F_1(2),\ 8 + F_1(3)]$$

$$F_2(3) = [5 + F_1(2),\ 8 + F_1(3)]$$

In general form, the expressions can be written as $F_2(x_2) = [w_2 + F_1(x_1)]$.

London Journal of Engineering Research

Finally $F_1(1) = 5,\ F_1(2) = 4,\ F_1(3) = 3$; in general $F_1(x_1) = w_1$ and derived with the general recursion formula

$$F_j\left(x_j\right) = [w_j + F_{j-1}\left(x_j - 1\right)] \text{ for } j = 4, 3, 2 \text{ with } F_1(x_1) = w_1$$

This can be summarized to determine $F_4(x_4)$ recursively as follows

$$F_1(1) = 5,\ F_1(2) = 4,\ F_1(3) = 3$$

$$F_2(1) = (6,\ 8) = 6\ ,\ F_2(2) = (7,\ 9,\ 11) = 7 \text{ and } F_2(3) = (9,\ 11) = 9$$

$$F_3(1) = (13,\ 12) = 12\ ,\ F_3(2) = (12,\ 11,\ 13) = 11\ ,\ F_3(3) = (10,\ 10) = 10$$

$F_4(1) = (13,\ 18,\ 16) = 13.$ Which is the least cost path.

The significant feature of the procedure is that once the minimum $F_j\left(x_j\right)$ for a particular value of x_j or a particular value of jth stage is computed, in subsequent computations of paths to x_{j+1} through the value of x_j, only the minimum path to it is already computed and needs to be taken into consideration. Other alternative paths to x_j may be ignored. This is similar to Bellman's principles of optimality [4].

The principles essentially state that in a multistage process without feedback, whatever the previous states and decisions are, The subsequent decisions must form the optimal policy with respect to the current state. A Process without feedback means subsequent decisions do not affect the states arising from decisions previously taken.

III. CONCLUSION

The import costs mentioned in the form of network arc levels are tentative and not actual costs. The actual costs are available to the refinery companies, seaport authority and oil importing companies. The statements made in the multistage least cost path determining model is synthesized in the form of graph network and algebraic form of solvation process. If the graph is more complicated with the larger number of vertices and arcs, a geometrical representation is hardly convenient and a numerical approach with computer application software can solve the new-port inclusion problem. By the way a new port in the form of a vertex and connective route cost in the form of arc labels are included in the array. Therefore the data in the tabular version of the problem description and problem solving procedure, which involves purely numerical computation starting and iterating tables are needed. Some of the examples such as transit node and arc value, state transformations, recursive operation pre and post operation numeric representation are also found in the standard Operations Research book. The tabular numerical data description is also useful for writing Computer programs for solving the Combinatorial Optimization and refinery operations resource problem.

International newspapers and Electronic media informs Indian Petrochemical refinery located at Indian seaports collect petroleum filled vessels from Kuwait, Oman, and Saudi Arab through the India western sea route and the ship engine fitted petroleum filled vessels reach at Indian seaports from western coast to South Indian coast and South Indian coast to East Indian coast, within a definite time period. The receiver seaport authority maintains Indian custom duty and alerts shipyard for downloading the petroleum, diesel and Kerosene oils within a definite time. The ship's sea route schedule is found from Merchant navy India web site to the registered petrochemical trader ships that are built under the Registrar shipyard supervision or Indian seaport authority.

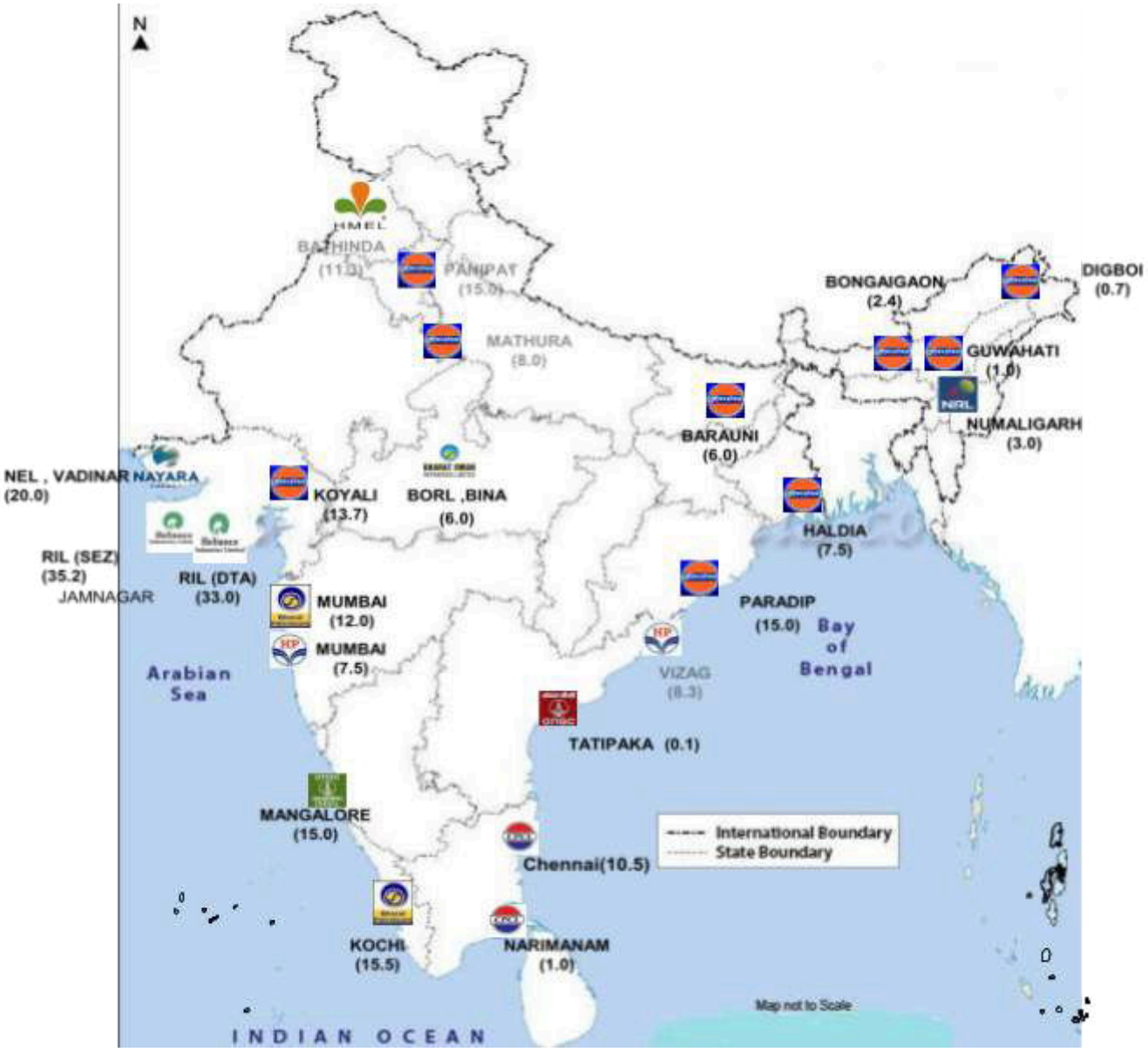
Mineral oil traders with Indian Government makes Legislation regulating Auto-Fuel trader's license and it is used to import refined mineral oil and it is an agreement between refinery oil merchant, oil seller and buyer industry to utilize the oil for healthcare industry product production.

The mineral oil trader license scaling process is a list of actions usually practiced in oil refill procedures for an unmanned gas station server pump task actuation logistic analytic. When a buyer refills fuels at an unmanned fuel station certain mechanical tasks operations such as holding pump gasket nozzles before, during and after refill at a fuel container engine tanker closed lid open and shut are performed. Container gas measure procedure such as the gas pressure pipe stretching jet nozzle on/off actuation after receipt signal from the electronic device, computing quantity force pressure to be put at pump end edges and cost price billing is also printed after fill the oil into the engine tanker. If the fuel is liquid, and one end of the pump fitted pipe is subjected to the engine tanker open lid, the pipe's other end is merged to the reservoir, and another pipe is fitted to the reservoir tanker for air pressure actuation and balancing. The mathematical fuzzy measure is the volume of oil transformed from a reservoir tanker layer transported into the engine oil tank through the pipe internal space. Either the volumetric difference in oil reservoir tanker, or the oil inflow and outflow at pipe end jet pressure or the engine oil tank filled space volume quantity is to be computed for bill purpose. But an easier way of oil measure is inner pipe space measure and multiplied with quantity time oil transported through the pipe at a normal air temperature and oil bottom layer pressure.

If the fuel is compressed gas, the mass of the gas is computed for receipt bill documentation,

Appendix A displays the map of petroleum refineries in India and Appendix B mentions the list of Petroleum refinery companies operating in India.

Appendix-A



S. No.	NAME OF THE OIL COMPANY	STATE	LOCATION OF REFINERY	CAPACITY (MMTPA)
1	INDIAN OIL CORPORATION LIMITED (IOCL)	BIHAR	BARAUNI	6.0
2		GUJARAT	KOYALI	13.7
3		WEST BENGAL	HALDIA	7.5
4		UTTAR PRADESH	MATHURA	8.0
5		HARYANA	PANIPAT	15.0
6		ASSAM	GUWAHATI	1.0
7		ASSAM	DIGBOI	0.7
8		ASSAM	BONGAIGAON	2.4
9		ODISHA	PARADIP	15.0
		IOCL TOTAL		**69.2**
10	USTAN PETROLEUM CORPORATION LIMITED (HPCL)	MAHARASTRA	MUMBAI	7.5
11		ANDHRA PRADESH	VISAKH	8.3
12	HPCL-HINDUSTAN MITTAL ENERGY LIMITED (HMEL) (JV)	PUNJAB	BATHINDA	11.3
		HPCL-TOTAL		**27.1**
13	BHARAT PETROLEUM CORPORATION LIMITED (BPCL)	MAHARASTRA	MUMBAI	12.0
14		KERALA	KOCHI	15.5
15	BPCL-BHARAT OMAN REFINERIES LIMITED (BORL) (JV)	MADHYA PRADESH	BINA	6.0
		BPCL-TOTAL		33.5
16	CHENNAI PETROLEUM CORPORATION LIMITED (CPCL)	TAMIL NADU	MANALI	10.5
17		TAMIL NADU	CAUVERY BASIN	1.0
		CPCL-TOTAL		11.5
18	NUMALIGARH REFINERIES LIMITED (NRL)	ASSAM	NUMALIGARH	3.0
19	OIL & NATURAL GAS CORPORATION LIMITED (ONGC)	ANDHRA PRADESH	TATIPAKA	0.1
20	ONGC-MANGALORE REFINERIES & PETROCHEMICALS LIMITED (MRPL)	KARNATAKA	MANGALORE	15.0
		ONGC TOTAL		15.1
		PSU/ JV Total		159.4
21	RELIANCE INDUSTRIES LIMITED (RIL)	GUJARAT	JAMNAGAR (DTA)	33.0
22		GUJARAT	JAMNAGAR (SEZ)	35.2
23	NAYARA ENERGY LIMITED (NEL)	GUJARAT	VADINAR	20.0
		PVT Total		88.2
ALL INDIA				247.6

Appendix-B

REFERENCE

1. https://en.wikipedia.org/wiki/Combinatorial_optimization
2. https://en.wikipedia.org/wiki/Vehicle_routing_problem
3. Taha H. A., Operations Research An Introduction, Pearson. Eighth edition. 2007.
4. Chander Mohan and Kusum Deep, Optimization Techniques, New age publisher, 2017.

This page is intentionally left blank

Prolonged Delusion

G.V. Skornyakov

ABSTRACT

The failure of some concepts taken roots in thermodynamics is established. The Second Law of thermodynamics is true only for all single- parameter or for fully integrated multi- parameter systems. The concept of entropy of a non-integrated system is illusory one.

Keywords: energy, entropy, laws of thermodynamics.

Classification: FOR CODE: 091599

Language: English

London Journals Press

LJP Copyright ID: 392932
Print ISSN: 2631-8474
Online ISSN: 2631-8482

London Journal of Engineering Research

Volume 20 | Issue 3 | Compilation 1.0

Prolonged Delusion

G.V. Skornyakov

SUMMARY

The failure of some concepts taken roots in thermodynamics is established. The Second Law of thermodynamics is true only for all single-parameter or for fully integrated multi-parameter systems. The concept of entropy of a non-integrated system is illusory one.

Keywords: energy, entropy, laws of thermodynamics.

Author: A.F.Ioffe Institute of Physics and Technology, Russian Academy of Sciences, St. Petersburg, Russia.

I. INTRODUCTION

The second century of existence of one of the most important branches of science - thermodynamics - ends. It is hardly an exaggeration to claim that its foundations were laid by Sadi Carno [1]. Thermodynamics is often compared to geometry. Like geometry, it is built on an axiomatic basis. In terms of the breadth of the coverage of phenomena, thermodynamics is not equal among physical theories. In this connection, in the mid-20th century, A.Einstein wrote [2]:

"The theory gives the greater impression the simpler its premise, the more diverse the subjects it binds, and the wider the scope of its application. Hence the profound impression that classical thermodynamics has made on me. It is the only physical theory of general content on which I am convinced that within the applicability of its basic concepts it will never be refuted (to a special note of principled skeptics). "

What did A.Einstein see as the most attractive features of thermodynamics? Recalling the creation of the theory of relativity, he emphasized [2]:

"Only the discovery of a general formal principle can lead us to reliable results. The sample was thermodynamics. There the general principle was given in the sentence: the laws of nature are such that it is impossible to build an eternal engine (the first and second kind)... The general principle of the special theory of relativity is contained in the postulate: the laws of physics are invariant regarding Lorentz transformations... This is a restrictive principle for the laws of nature that can be compared to the underlying thermodynamics restrictive principle of non-existence of the eternal engine. "

The question of compatibility of both axioms underlying thermodynamics and their compliance with the laws of nature did not even arise. The task of thermodynamics from the very beginning was not so much to find ways to convert heat into work, but to explain the mechanism of action of long-existing thermal machines and improve their characteristics. It put an indelible imprint on her. The presence of a heater and a cooler is a characteristic feature of such processes.

II. PFAFF EQUATIONS AND ENTROPY

An attempt at general analysis of thermal processes based on Pfaff equations describing their course was made by C.Caratheodory [3]. Probably, he did not know that the conditions of integrability of Pfaff equations in general long before him were established by G.F.Frobenius [4] and devoted to the proof of lemma from the theory of Pfaff equations a separate section of his article. In his understanding, heat migration occurs solely as a result of thermal conductivity and always from the hot body to the cold. Thus, acoustics were excluded from consideration. The visibility of the commonality of C.Caratheodory's

approach can create the set of all possible processes introduced by him between any two points of the space of thermodynamic variables, to which he attributed the property of connectivity without any reason. Accepting the dependence of the energy produced on the transition path, he tacit suggested that all other quantities he used were unambiguous. As a result, C.Caratheodory concluded that the Pfaff equations of all thermal systems at any number of variables are integrable.

Such a strong claim fell on favorable ground and gave additional weight to the arguments of supporters of the broadest interpretation of the concept of entropy. The illusion of the existence of entropy was not completely groundless. The number of independent variables of the thermodynamic system by one exceeds the number of its external parameters. Over the years, the vast majority of cases have considered different systems with a single external parameter. Regardless of their nature, the corresponding Pfaff equations have an integrating multiplier.

For the case of three independent variables, the condition of existence of the integrating multiplier of Pfaff equations was also known by L.Euler. With the increase in the number of independent variables, the number of integrability conditions grows much faster than the number of independent variables, which makes the very possibility of integrability of Pfaff equations quite exceptional [5].

However, you do not need to increase the number of external parameters to build a non-integrated system. They have long been known - thermally non-uniform systems of two gases separated by a movable heat-tight partition [6]. The condition of existence of the integrating multiplier of Pfaff equations for them, and therefore entropy, is the coincidence of specific heat capacities of gases. Guided by the additivity property of entropy, the author "pre-defined" the entropy of the system as the sum of the entropies of its parts. This "pre-definition" of non-existent magnitude, along with the equally meaningless use of known entropy properties, brought her to the conclusion that thermally non-uniform systems and conventional axioms of thermodynamics were compatible. For many years this clumsy of ridiculous things not only met no objections, but also entered into a number of textbooks of thermodynamics. In fact, the author "held in her hands" the eternal engine of the second kind, but without knowing how to use it, "proved" its inoperable ability. The solution of the issue literally lay on the surface [7].

III. BAROMETRIC FORMULA

The processes of converting heat into work are an important but far from the only area of mismatch of thermodynamics findings with facts. First of all, this applies to the barometric formula for gases. According to it, the pressure of the Earth 's atmosphere falls exponentially with altitude, but the temperature does not depend on altitude. Of course, the Earth 's atmosphere does not belong to thermodynamically equilibrium systems, and it is only possible to talk about its local characteristics as average in a sufficiently long period of time, but snow in high-mountain areas is an indispensable fact. The centrifugal force field has a similar effect on the gas temperature.

Based on the unlimited decrease of gravitational interaction with the distance to the planet they were guided to the conclusion that the atmosphere of planets dissipate [8]. Taking into account the dependence of gas temperature in the gravitational field on altitude results in a sharp boundary of the atmosphere of the gas held by the planet [9].

IV. CONCLUSION

Numerous examples of different nature, which do not fall within the limits of conventional axioms of thermodynamics, are given by V.A.Etkin [10]. One can only hope that by its two-century anniversary thermodynamics will get rid of the illusion of the impossibility of completely converting heat into work and gain an adecvate understanding of the problems before it.

REFERENCES

1. Carnot S. Réflexions sur la puissance motrice du feu et sur les machines propres a développer cette puissance.// Paris, 1824
2. Albert Einstein: Philosopher-Scientist, ed. By P.Schlipp,// Evanston, Ill. 1949.
3. C.Caratheodory, Untersuchungen uber die Grundlagen der Thermodynamyk.// Mathematische Annalen, **67** (1909), 355—386.
4. Mathematical Encyclopedia, vols. 1--5 (In Russian), // Moscow SE, 1977—1985.
5. Skornyakov G.V. On Thermodynamics // Tech.Phys. 1996, № 1, pp1—11.
6. Afanas'eva-Ehrenfest T. A., Irreversibility, One-Sidedness, and the Second Law of Thermodynamics, // Zhurn. Prikl. Phys. (In Russian), 1928, vol. 5, parts 3--4, pp. 3—30.
7. Skornyakov G.V. Problem of Energy and the Second Law of Thermodynamics // International Journal of Energy and Power Engineering 2019; 8(1): 1-3.
8. Landau L. D. and Lifshits E. M., Statistical Physics (In Russian), Moscow, Nauka, 1964, 568 pp.
9. Skornyakov G. V., Principles of the theory of thermal processes, LAMBERT Academic Publishing, 2017.
10. Etkin V. A. Paralogisms of thermodynamics. (In Russian)– Saarbrücken, Palmarium Ac. Publ., 2015.