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Metal Bioaccumulation/Toxicity Test for Metal Industry Wastewaters

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Abstract: Metal industry wastewaters include different types of heavy metals with respect to the metal production processes and products. There are several methods used for metal production industry such as refining and smelting operations. Both may produce air emissions like SO₂ and particulate matter, wastewater originating from floatation and leachate, and other wastes like sludge and slag. Heavy metals of metal industry wastewaters are nickel, brass, chrome, gold, cadmium, copper, brass, and silver. Most of them may give severe damage to human and environment. For example, chrome ion leads to lung cancer, stomach ulcer, kidney and liver function disorders and death on human. Thus, heavy metal containing wastewaters could be very dangerous. Besides, plant species which have capability of accumulate heavy metals can be an option to bioaccumulate metal industry wastewaters while plant species which are sensitive to heavy metals can be used as a plant for phytotoxicity tests. In this study metal industry wastewaters were analysed in order to determine plant species whether they are sensitive or tolerant to heavy metals. During analysis phytotoxicity tests were conducted with different plant species.

Keywords: Metal Wastewaters, Bioaccumulation, Heavy Metals, Toxicity.

INTRODUCTION

Heavy metals found in wastewaters mainly originating from metal industry and mining activities. The main pollution sources from metal industry originating from metal smelting and metal refining activities. The main purpose of metal working industries is obtaining instruments, machinery, machine components and tools that are necessary for economic purposes. Moreover, there are several different techniques present for metal manufacturing process such as casting, hammering, welding, cutting and shaping of metals ^[1]. Environmental consequences of smelting and refining of heavy metal ores are considerable. Especially three heavy metals namely copper, lead and zinc are very problematic pollution sources. They can produce SO₂ emissions and particulate matter, wastewater coming from leachate and wash down waters, and other wastes such as sludge and slag production. These pollutants are very harmful for the environment around the metal industries and with the help of wastewater, negative impacts may be transported to different areas ^[1].

Heavy metals linked with significant effects on human health are lead, mercury, arsenic, copper and cadmium ^[2]. These heavy metals could be found in different sources and human exposure is possible from air, water, plants and especially soil. When the concentration of heavy metals reached to toxic levels, consequences could be dangerous such as paralysis, stomatitis, tremor, diarrhoea, haemoglobinuria, gastrointestinal (GI) disorders, paralysis, vomiting depression, and pneumonia because of inhalation of gaseous products and particulate matters ^[3]. Furthermore, cancer formation is possible long-term effect of continuous heavy metal accumulation by humans ^[2]. Therefore, it is very important to understand heavy metal content of what we are exposed.

Bioaccumulation of heavy metals is important for decreasing the effects of them minimum. It is one of the cheapest and easiest way of reduction of pollution amount. Different plant species could be used as bioremediation material. To determine which plant is appropriate especially for heavy metal pollution, several techniques are used. Toxicity tests are the mostly used technique for understanding response of the plants. In this paper, different studies which have investigated several plant species were reviewed and their response against heavy metals were compared. Main heavy metals considered are lead (Pb), cadmium (Cd), zinc (Zn), copper (Cu), mercury (Hg). Different plants such as *Zea mays L.*, *Lepidium sativum*, *Lolium perenne*, *Lactuca sativa* etc. have given variant of reaction against increasing concentrations of heavy metals.

MATERIAL AND METHOD

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Phytotoxicity tests are very important to understand tolerance of some plant species against different toxic materials. The main idea behind this test is understanding the capacity of a compound to cause temporary or permanent damage to plants ^[4]. There are several tests which have been developed for this purpose. Main standard methods used for phytotoxicity test are ISO 11269-2 (Effects of chemicals on the emergence and growth of higher plants), OECD 208 (Guideline for the testing of chemicals), CEN/TC 223 (Biostat for assessment of phytotoxicity), ÖNORM S 2021 (Quality Requirements and test methods), VDLUFA (Evidence of phytotoxic and gaseous phytotoxic substances in soils, horticultural substrate and composts). These methods are described as standards or draft standards for phytotoxicity testing ^[5]. They are developed by different countries with respect to the regulatory requirements or scientific projects.

ISO 11269-2 Method

This method was developed in 2005 and revised in 2012 by Technical Committee ISO/TC 190. The main purpose of this method is evaluation of the unknown soil quality and habitat function by monitoring the growth of two different plant species compared with standard control soils. Also, the method is appropriate for the soils of unknown quality such as soils from contaminated sites and soils after remediation ^[6]. This method is applied in specific places like green houses and plant growth rooms. Also, the containers used for planting has some specific features with respect to plant species used for tests. Rye, ryegrass, perennial, rice, oat, wheat, soft, barley, Sorghum, Sweetcorn, mustard, radish, turnip, Chinese cabbage, birds foot fenugreek, Lettuce, Cress, garden, Tomato, Bean are the main plant species which may be used for application of tests. Test parameters considered are number of seedlings emerging, number of plants remaining at harvest and total mass (fresh or dry) at harvest ^[5]. ISO 11269-2 Method is suitable for understanding the effects of chemicals on the emergence of and growth of higher plants.

OECD 208 Method

It is the mostly used method for the assessment of potential effects of different substances on seedling emergence and growth of plants. OECD Guidelines are updated periodically within the scope of scientific renewals and new regulations. Sandy loam, loamy sand and sandy clay loam soil including maximum 1.5 percent organic carbon are the main soil types which can be used as a medium for plant growth. Generally, dicotyledonae such as sugar beet, mustard, cabbage, turnip, cucumber, tomato, soybean and monocotyledonae such as rice, corn, onion, wheat, barley family plant species are used in this method. The effects of test material on the plant growth are assessed following 14 to 21 days before the plantation. The main visual evaluation criteria of the method are emergence of seedling and biomass, and presence of detrimental effects such as chlorosis, mortality, abnormalities in plant development. Weekly measurements are done for comparison of seedlings with the control group ^[7]. Schematic representation of OECD Method is given in Figure 1.

Other Techniques

Moreover, there are other analyses which can be used for investigating the tolerance of plant species against pollutants. For example, measurement of physical and chemical characteristics such as cation exchange capacity, electrical conductivity, organic matter, soil reaction. With the help of the statistical analysis, changes in these parameters before and after test period help to determine tolerance of plants ^[9]. Furthermore, assessment of chlorophyll a fluorescence, photosynthetic pigments and enzymatic activity of superoxide dismutase could be other options for this purpose ^[10]. Mostly used statistical method after the test and measurements related to plant reaction against pollution is one-way variance analysis (ANOVA). With the help of the ANOVA statistical significance of mean values of different groups may be determined. The main assumption of ANOVA is that independent variables affect dependent variable. Capability of testing the effects of more than one variable is the main advantage of variance analysis ^[11].

Plant Selection

Plant selection for determining the tolerance could be done with respect to consider previous studies and engineering judgement. Plants which have high biomass production capability are possible to be

used in experiment. Moreover, if the plants are resistant to salty and sodic environment, they could be good candidates for experimental analysis of heavy metal pollution.

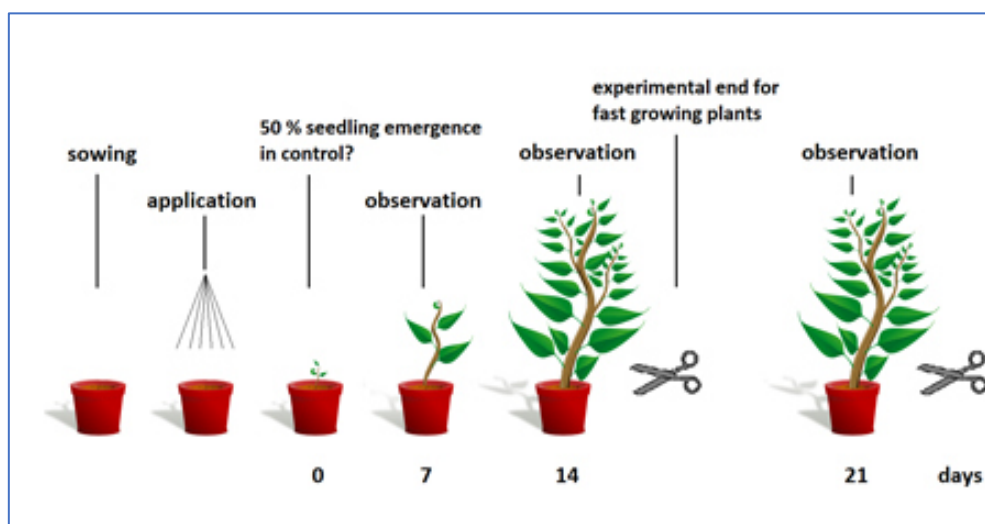


Figure 1. Schematic Representation of OECD 208 Method ^[8]

RESULTS

Heavy metal accumulation of different plant species is important criteria for usage of them as a bioremediation technique. If their tolerance is high against to the pollutants, they could be used for treating pollution. Industry wastewaters which contain several heavy metals could be source of pollution in several areas. The response of the plants against heavy metals coming from this source gives information about the plants for determine their usage purpose. In Table 1, the plant species which show high tolerance against the heavy metals are given and in Table 2, the plant species which show moderate and low tolerance against the heavy metals are given.

Table 1. The plant species which show high tolerance against the heavy metals

Plant Species	Use of Plant	Heavy Metals	Response
<i>Zea mays L.</i>	Food	Pb, Cd	High tolerance to Cd and Pb pollution ^[9]
<i>Zea mays L.</i>	Food	Zn, Cu	High tolerance to Cu pollution, poor tolerance to Zn pollution ^[10]
<i>Brassica sp.</i>	Food	Cd, Pb, Cu, Zn	High tolerance to main heavy metals ^[12]
<i>Lactuca sativa</i>	Food	Cd, Pb	High tolerance to Cd pollution, moderate tolerance to Pb pollution ^[13]
<i>Pisum sativum</i>	Food	Cd, Cr, Cu	High tolerance to Cu pollution, moderate tolerance to Cr and Cd pollution ^[16]
<i>Salvina cucullata</i>	Ornamental	Cd, Cr, Cu, Pb, Zn	High tolerance to Zn pollution, low tolerance to Cd, Cr, Cu, Pb pollution ^[18]
<i>Trifolium repens</i>	Landscaping	Cd, Pb, Zn	High tolerance to Cd, Pb, Zn pollution ^[20]

Table 2. The plant species which show moderate and low tolerance against the heavy metals

Plant Species	Use of Plant	Heavy Metals	Response
<i>Lepidium sativum</i>	Food	Hg	Moderate tolerance to Hg pollution, tolerance can be increased with the help of compost and KI. ^[14]
<i>Lolium perenne</i>	Ornamental	Cu, Pb, Zn	Low tolerance to Cu, Pb, Zn pollution ^[15]
<i>Spinacia oleracea</i>	Food	Cr, Cd, Zn	Moderate tolerance to Cr, Cd, Zn pollution ^[19]
<i>Lolium perenne</i>	Ornamental	Cd, Pb, Zn	Low tolerance to Cd, Pb Zn pollution ^[20]
<i>Solanum lycopersicum</i>	Food	Cd	Low tolerance to Cd pollution ^[17]

CONCLUSION

Heavy metals originating from industry wastewaters have significant effects especially on human health, plants and animals. Most of them directly affects the quality of the soil, water and air so they should be removed from the wastewaters. Their removal from environment may be provided by several methods such as advanced oxidation, adsorption on new adsorbents, membrane filtration, electrodialysis, and photocatalysis. One of the easiest and cost-effective method is removal of the heavy metals with the help of the plants. Their tolerance against heavy metal contamination of different concentrations prove their ability of bioaccumulation. Within the investigated plant species in this study, high tolerant species against Cu are *Zea mays L.* and *Pisum sativum*, high tolerant species for Pb pollution are *Zea mays L.* and *Trifolium repens*, high tolerant species against Cd pollution are *Zea mays L.*, *Lactuca sativa* and *Trifolium repens*, and high tolerant species against Zn pollution are *Salvina cucullata*, *Trifolium repens*. However, some species show low or moderate tolerance against different heavy metals. They can be used for other purposes. For example, *Spinacia oleracea* and *Solanum lycopersicum* are not effective candidates for Cd pollution but they can be used for treatment purposes when the low concentrations occur. Also, *Lepidium sativum* has moderate tolerance against Hg but it very important because the presence amount of Hg in soil is not so high in most of the situations. As a result, it is possible to find several plants for bioaccumulation of heavy metals and *Zea mays L.* is the best one which may be used for bioaccumulative removal of Cu, Pb and Cd pollution.

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Review of Estimation The Effects of Petroleum Refinery Effluents on The Physicochemical Properties for Surface Water

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Abstract: Industrial wastewaters entering a water body represent to an overwhelming wellspring of natural contamination in waterways. It influences both the water quality and the microbial and amphibian greenery. With contending requests on constrained water assets, attention to the issues required in water contamination, has prompted to significant open level-headed discussion about the natural impacts of Industrial effluents released into oceanic situations. Raw petroleum, refined petroleum items, and in addition polycyclic aromatic hydrocarbons are universal in different natural compartments. They can bioaccumulation in natural pecking orders where they upset biochemical or physiological exercises of numerous living beings, in this manner bringing about carcinogenesis of a few organs, mutagenesis in the hereditary material, impedance in conceptive limit and/or creating and causing hemorrhage in exposed population. The cause/impact of oil poison are typically evaluated by utilizing organic end guide parameters alluded toward as biomarkers. Defilement of soil emerging from spills is a standout amongst the most constraining components to soil ripeness and consequently edit profitability Petroleum Refinery, Petrochemicals effluents are described by their irregular turbidity, conductivity, chemical oxygen demand (COD), total suspended solids (TSS), Biological oxygen demand (BOD), and total hardness. Petroleum Refinery, Petrochemicals effluents containing high grouping of microbial supplements would clearly advance an after-development of essentially high coliform sorts and other microbial structures. Natural contamination is constantly obvious, and the contamination is aggravated via arrive based sources, for example, the infrequent release of crude sewage through tempest water outlets, the effluents from refineries, oil terminals, and petrochemical plants. Squander effluents rich in decomposable natural matter, is the essential driver of natural contamination.

Keywords: COD, Industrial wastewaters, Petroleum Refinery, TSS, Surface Water.

INTRODUCTION

A standout amongst the most basic issues of creating nations is disgraceful administration of huge measure of squanders produced by different anthropogenic exercises. Additional testing is the dangerous transfer of these losses into the surrounding condition. Water bodies particularly freshwater supplies are the most influenced. This has frequently rendered these characteristic assets unsatisfactory for both essential or potentially optional utilization ^[1]. The Industrial wastewaters entering a water body represent to an overwhelming wellspring of natural contamination in waterways. It influences both the water quality and the microbial and amphibian greenery. With contending requests on constrained water assets, attention to the issues required in water contamination, has prompted to significant open level-headed discussion about the natural impacts of Industrial effluents released into oceanic situations Raw petroleum, refined petroleum items, and in addition polycyclic aromatic hydrocarbons are universal in different natural compartments. Furthermore, it can be bioaccumulation in natural pecking orders where they upset biochemical or physiological exercises of numerous living beings, in this manner bringing about carcinogenesis of a few organs, mutagenesis in the hereditary material, impedance in conceptive limit and/or creating and causing hemorrhage in exposed population. The cause/impact of oil poison are typically evaluated by utilizing organic end guide parameters alluded toward as biomarkers. Defilement of soil emerging from spills is a standout amongst the most constraining components to soil ripeness and consequently edit profitability ^[2].

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USING OF WATER BODIES AS SINK FOR INDUSTRIAL EFFLUENTS

The Population blast, perilous fast urbanization, mechanical and innovative extension, vitality use and squanders age from residential and modern sources have rendered many water assets unwholesome and dangerous to man and other living assets. Water contamination is presently a critical worldwide issue, The Industrial effluents are a main source of direct and often continuous input of pollutants into aquatic ecosystems with long-term implications on ecosystem functioning including changes in food availability and an extreme threat to the self-regulating capacity of the biosphere. These industrial discharge or wastes include heavy metals, pesticides, polychlorinated biphenyls (PCBs), dioxins, poly-aromatic hydrocarbons (PAHs), petrochemicals, phenolic compounds and microorganisms.

These wastes are usually discharged into water bodies and the cumulative hazardous effects it has on the environment have received much attention. Industrial wastes containing high concentration of microbial nutrients would obviously promote an after growth of significantly high coliform types and other microbial forms ^[4].

On the other hand, some heavy metals contained in these effluents have been found to be carcinogenic while other chemicals equally present are poisonous depending on the dose and duration of exposure. Undoubtedly, wastewaters from industries and residential areas discharged into another environment without suitable treatment could disturb the ecological balance of such an environment.

Table 1. The Examples of Waste Effluents Generated by Selected Industries ^[5]

Type of waste	Type of plant
Oxygen-consuming	Breweries, Dairies, Distillers, Packaging houses, Pulp and Paper, Tanneries, Textiles
High Suspended Solids	Breweries, Coal washees, Iron and Steel Industries, Distillers, Pulp and Paper mills, Palm oil mills
High dissolved solids	Chemical plants, Tanneries, Water softening
Oily and grease	Laundries, Metal finishing, Oil fields, Petroleum refineries, Tanneries, Palm oil mills
Colored	Pulp and Paper mills, Tanneries, Textile dye houses, Palm oil mills
High acid	Chemical plants, Coal mines, Iron and Steel, Sulfite pulp
High alkaline	Chemical plants, Laundries, Tanneries, Textile finishing mills
High Temperature	Bottle washing plants, Laundries, Power plant, Textile

The Industrial effluents are characterized by their abnormal turbidity, conductivity, chemical oxygen demand (COD), total suspended solids (TSS) and total hardness. The effluent total hardness concentrations of a chemical-biological treatment plant were found greater than the influents. The results are presented in terms of the relative flux as a function of time related to hydrodynamic conditions and pollution characteristics of wastewater ^[6,8].

SOME SOURCES OF THE INDUSTRIAL EFFLUENTS

Pharmaceutical industry

Industrial and Mechanical assembling forms in the pharmaceutical business create wastewater that is for the most part described as high quality natural emanating - squander streams that can be trying to make do with ordinary wastewater treatment ^[9].

Soap and detergent Industry

One of the primary outcomes of the abnormal state of surfactant creation is the in-wrinkle in the contamination caused by squander waters originating from assembling plants of toiletries and cleansers amid the washing forms ^[10]. The high and differed contamination heaps of these effluents are predominantly because of the leftover items in the reactor, which must be washed away keeping in mind the end goal to utilize a similar creation lines for the fabricate of different items. Paper process industry.

Textile mill effluent

The material coloring industry devours expansive amounts of water and creates extensive volumes of wastewater from various strides in the coloring and completing procedures. Wastewater from printing and coloring units is frequently rich in shading, containing deposits of responsive colors and chemicals, for example, complex parts, numerous mist concentrates, high unending, high COD and BOD fixation and also significantly more hard-debasement materials. The poisonous impacts of dyestuff and other natural mixes, and in addition acidic and antacid contaminants, from modern foundations on the overall population are generally acknowledged. At show in the Table 2 below, the colors are fundamentally sweet-smelling and hetero-cyclic mixes, with shading show gatherings and polar gatherings. The structure is more muddled and stable, bringing about more prominent trouble to corrupt the printing and coloring wastewater ^[11].

Brewery industry

The treatment of profluent for reuse is the favored and most broadly bolstered procedure. Wastewater from bottling works operations has a high supplement fixation and the customary technique for transfer by conveying the water to a civil sewage treatment plant is both inefficient and a wellspring of worry for downstream beneficiaries. What's more, treatment of wastewater by metropolitan treatment plants speaks to an exceptionally noteworthy cost to distillery administrators. Given the potential estimation of supplement rich distillery wastewater, and the need to moderate water use, it in this way bodes well to discover different utilization for the wastewater and in addition a method for utilizing less water generally speaking ^[12].

Tannery industrial effluent

The Manufacturing of leather, leather goods, leather boards and fur produces numerous by products, solid wastes and high amount of waste water containing different loads of pollutants and emission in to the air. The transformation of the raw hide into leather requires various mechanical and chemical treatments and is generally carried out using different acids, alkali and salts of sodium and chromium, the leather industry is one of the highly polluting industries. The uncontrolled release of tannery pollutants into natural water bodies increases the health risk for human beings and environmental pollution ^[13].

Table 2. The Palm oil mill effluent (POME) characteristics ^[7]

Parameters	Average values
BOD	23,000mg L ⁻¹
COD	55,000mg L ⁻¹
TN	650mg L ⁻¹
TP	120mg L ⁻¹
OIL	10,000mg L ⁻¹
COD Volatile fatty acids	1,000mg L ⁻¹
pH	4-5
Temperature	45-70 °C

Soft drink effluent

Every one of the Processes and frameworks that have been utilized water today are being subjected to progressively stringent natural directions on effluents and there is developing interest for new water. These progressions have expanded the requirement for better water administration and wastewater minimization. The mix of water request supervision and cleaner creation ideas have brought about both monetary and environmental advantages ^[14].

Chemical industry

The substance business involves the organizations that deliver modern chemicals. Essential chemicals or commodity chemicals are a wide synthetic class including pharmaceutical items, polymers, mass petrochemicals and intermediates, different subsidiaries and fundamental mechanical, inorganic/natural chemicals, and composts. The compound business is of significance regarding its effect on the earth. Synthetic mechanical wastewater more often than not contain natural and inorganic

issue in fluctuating fixations. Numerous materials in the concoction business are dangerous, mutagenic, cancer-causing or just nearly non-biodegradable. This implies the creation wastewater likewise contains an extensive variety of substances that can't be effortlessly corrupted. For example, surfactant and oil hydrocarbons, among others compound items that are being utilized as a part of concoction industry diminish execution effectiveness of numerous treatment unit operations ^[15,16].

CONCLUSION

To give an all-encompassing methodology toward water contamination reduction, aversion at the source is the best option. Having recognized these real water contamination sources in this review, ought to as an issue of methodicalness, receive lawful, managerial and specialized measures to dispense with or decrease the unwanted impacts of mechanical effluents in water bodies. Burden of direct charges on mechanical effluents by the controlling organization, and also ceaseless observing and observation is basic keeping in mind the end goal to guarantee the insurance of water assets from encourage debasement because of contamination.

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Insects as Food and Feed in The Turkey: Current Behaviours

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Abstract: Insects which have begun to be seen as the main food source, are becoming increasingly popular in food and nutrition. When we look at foreign studies of insects research within a decade, those concerning edibility seem to have increased in the last three years. This study provides an overview on the perception and acceptance by consumers of insects as an alternative food source in Turkey and comprises a social experiment. For this purpose, the study was carried out on a total of 100 people attending "Nutrition Education" and "New Trends in World Cuisine", and pre- and post-training behaviours were observed. It understood that the majority of the individuals participating in the study did not see insects as a food source and would have been consumed if they were religiously appropriate. Despite the work being done, the question remains unanswered as to whether or not edible insects will have the potential to gain a position in the Turkish cuisine in the coming years.

Keywords: Alternative Food, Edible Insects, Consumer Behaviours, Turkey

INTRODUCTION

The human being who has been seen as a consumer since the early ages of human history; are known to be affected by the lifestyles of the eating habits (such as nomadic and sedentary life), the settlement area, and the civilizations with which they interact ^[1,2]. Nutritional status can also be shaped by the behaviour of the consumer. For example; starting from personal characteristics, the ability to buy goods and services from the economic point of view, the ability to access services, and knowing what you want (consumer awareness). In addition, the process of individual decisions about which goods and services to buy, how, where, when, and when to buy or not is affected by this behaviour; ^[3] Consumer behaviour is a broad concept; ^[4] that consumers cannot be precisely explained why they buy or do not buy a product. The perception system that affects consumer behaviour is; many stimulants coming to people's sensory organs are simply ignoring other stimulants by concentrating on any situation and object ^[5]. Thus, the diversity of consumer behaviours regarding nutrient uptake;

- Demographic Characteristics (age, gender, education, income level etc.)
- Geographic Features
- Physiological status (growth, development, pregnancy and breastfeeding status, etc.)
- Psychological Condition
- Health Status (drug use, genetic disease, etc.)
- Faith Status (Morality, sect, tradition)
- Sensory properties (pleasure, taste, smell)
- Perception (media, advertising, internet, etc.) it is based on factors ^[5].

It is expressed that personal values such as tradition and religious beliefs play an important role in shaping consumer behaviours by researchers ^[6]. However, it can be said that the psychological factors considered as experienced / unexperienced experienced to decrease or the increase of consumption in nutrition are also important. Because the possible fears of a good or bad experience about a food are reflected in the person's nutritional preference for rejecting the food ^[7, 8]. The qualities of the food such as what is the food, how to prepare and cook, the appearance of the food, the consistency, the warmth, the colour, the smell and the most important taste etc. reveal the quality of the food and the effect (positive or negative) on the individual's food preferences ^[9]. In a study conducted, it was found that as income increases, people eat less bread ^[10]. In other words, the economic situation of families and institutions also affects their consumption habits. Accordingly, personal demographic characteristics and sensory pleasure (sensory memory) are of great importance in the selection of food, in the emergence of nutrition habits of the individual. It is known that eating habits begin in the womb and

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This study was presented as a poster presentation at The International 4th Halal and Healthy Food Congress (15 July 2017, Ankara, Turkey) and published as abstract in the abstract book.

fetuses are known to have learned habits here ^[11]. If the basic food items are not taken more than once, various diseases are seen in the individuals and it is necessary to create a menu depending on the necessity of nutrition ^[12]. Although the transportation and consumption of food to the food items is due to the food source, the geographical variety in which the person is living varies in the choice of food. One who wants to consume protein in our country can supply this need sheep's in Central Anatolia, cattle breeding in Eastern Anatolia, seafood and legumes in the Mediterranean, and insects in countries like Asia-Africa ^[5, 13]. Insect consumption, not in Turkey; it has long been used as one of the main foodstuffs in Asia, Africa, Latin America and even Australia. Insects are the reason for the growing world population to be discussed as a new / alternative source of protein that has a potential for ecological (positive) and economic value compared to the need for nutrition and traditional animal breeding. Every country and every nation that has different gastronomic cultural heritages around the world is diversified in terms of approaches to new food products, acceptance rates, culture. For example, in tropical regions while the defeat of insect species nearly two thousand, Luxembourg and Turkey was also in shows uncertainty about the insect consumption in certain countries ^[14, 15]. Numerous insect species appear to be culturally important as nutrient values that are both harmful, disgusting and frightening for some societies in the history of humankind, while attracting interest for others (egg, honey, pollen, silk), as well as forensic cases and laboratory use as model organisms ^[16]. Insects can be used as food additives in the arts (literary, novel, poetry, film, games, music, handicrafts), dreams, history, religion, public health as well as small and large cattle breeding and fish meal production as a result of their work ^[17, 18]. From the perspective of Turkish culinary culture, there is no other study about the renewability of insects until now. In order to be able to be determined in social experiments; the performances of the individuals and the performances of the control group should be compared without any intervention before and after the pre-training situations, the obtained data should be evaluated in the desired behaviour, the positive expectations are evaluated as negative, and the external behaviours are evaluated as negative ^[19, 20, 21, 22]. Targeted behavioural development is determined by comparing the success of the application with control and experimental groups ^[21, 22, 23]. Insects in Turkey generally harmful and frightening as by: insect proteins in many countries, carbohydrates, trace elements, thanks to amino acids and minerals in terms of nutritional value of high and low-fat occurs has led them to be seen among food deemed appropriate in terms of health.

This study attempts to address the possible position of edible insects as an old nutrient and new / alternative food in many international studies. Turkey in insects by providing an overview of the available data on food as perceived from the perspective of the consumer and acceptance comprises a social experiment. It is being debated whether the "feeding with insects", which is starting to be seen as new / alternative food, cannot be used with various perception systems in our country.

MATERIALS AND METHODS

Konya Necmettin Erbakan University Gastronomy Culinary Arts undergraduate and graduate students were selected as research universes. The study group consisted of approximately 14 weeks (average 40-45 for each presentation) of "Edible Insects as Alternative Food Source" between January and June 2017, randomly selected from students with nutritional awareness of alternative foods and processing systems, was performed. The responses given before and after the training were recorded ^[22]. The study was conducted on edible insects in the context of new food products identified by Siegrist ^[24]. The choice of edible insects as food affects a variety of factors, including cultural, social, environmental and religious responsibility, obstacles, one's own risk behaviour, and anxieties. The study presents a framework that captures the evaluation process for acceptance (positive behaviour / usability) or refusal (negative behaviour / unusable thought) of young consumers when new food products are introduced to the market. Because the exhibited behaviour is not a similar study and social experiment on insects; The observation form which was developed ^[25] and its validity is 88% was arranged according to the training, positive (perspective to be attained) and negative (external behaviours to be attained) behaviours. Frequency is taken into consideration in data analysis. Thus, the attitudes of the individuals in our country on the consumer perception of edible beetle availability are evaluated.

RESULTS

In the study, Konya Necmettin Erbakan University observed the behaviours of second year and undergraduate students who are thought to be aware of the insects by taking the fall semester "New Trends in the World Cuisine" undergraduate students of Gastronomy Culinary Arts. What people consume insects as food in Turkey, and so they are willing to volunteer, and aimed to reveal the factors that affect this situation.

According to the sample size of the universe ^[26], the expected and observed students are seen in Table1. Students who come to class regularly and agree to participate in the work are included.

Table 1. Students taking the "New Trends in International Cuisine" course

	Education Period	Hoped	Present
Undergraduate	First Branch	61	56
	Second Branch	36	34
Graduate	First Branch	10	10
	Totally	107	100

Demographic characteristics are shown in Table 2, with the vast majority of students being undergraduates (90%) with an average age of 18 to 25 years. 52% of the respondents were male and were found to be mostly single.

Table 2. Demographic characteristics of students

Demographic	Age	Undergraduate	Graduate	Totally
Period	First Branch	56	10	100
	Second Branch	34		
Age	≤17	1	-	1
	18-25	85	9	94
	≥26	4	1	5
Gender	Female	43	5	48
	Male	47	5	52
Marital Status	Married	5	-	5
	Single	85	10	95

In this study, which is regarded as an alternative food, it is thought that this study will be beneficial in determining the edibility of insects in our country and revealing what has been paid attention to renewable foods. Individuals participating in the study did not see insects as food source before training (92%) and after education they showed negative behaviour by falling to 74%; it was found that the positive behaviours that the students could prefer beetles were 8% before training and 26% after training (Figure 1).

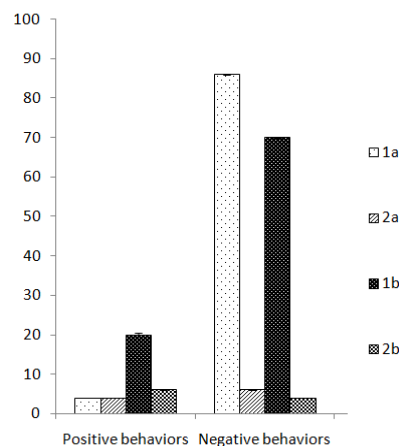


Figure 1. Edible insect behaviour of students before and after training (1. graduate, 2. showing graduate students; a. behaviours performed in the pre-training period, b. post-training behaviours)

The positive behaviour of the participants is low, because the effect of the religious opinion factor is high.

DISCUSSION AND CONCLUSION

Despite the fact that there are many studies on consumer's eating habits and attitudes and behaviours related to food preferences, Turkish culinary culture, new food cultures and practicing knowledge [27, 28, 29, 30,31, 32, 33, 34] there is no study about possible consumer behaviours for feeding with insects and country. Agricultural areas, geographical food sources, safe food transportation concerns due to global warming and environmental factors increase the tendency of people to alternative foods and products. With this anxiety, people are seeing to new trends such as artificial meat and 3D technologies, edible flowers, insect feeding, waste-free kitchens, no from plate nutrition from the capsule [18].

In a study of five 5 insect species found to have a higher nutritional value than other insects [35]; It has been reported that the protein content of insects is higher than that of the most widely accepted animal meat (cattle and pig) in the world, and the amount of fat is small and healthy compared to other meats. In a survey in Thailand, participants said they did not know that their feeder value despite insects feeding was high (83. 9%) [36]. In our study, it was determined that the amount of protein of the insects was high during the training and that the participants in the usability of the food shortage had positive behaviours.

In studies of nutritional behaviour, it is desirable that participants under age 18 be under 18 years of age (99%) as if we were working for [37] that they would not be able to express nutritional habits and continue the nutritional recovery period. In the same study, the average age of individuals who consume insects in Kenya (234 individuals), known to consume insects in Africa, is 41. 88% of these participants say they have consumed some edible insect species [37]. In this group, it is stated that insects are seen as an alternative food source against meat, and that their preference for possible risk factors affect their behaviour in food selection. Religion affects consumer behaviour with being an important source of motivation [38]. Increasing awareness of the Muslim population in the world has increased the prejudice given to halal food by affecting their behaviour [18]. In this case, consumers with Islamic beliefs do not consume edible insects and their products. Contrary to the work [37] it is seen in our country that one of the important factors that affect / restrict the nutritional behaviours of the consumers is not the possible risks but the belief situation. In terms of insects, it is stated that other insects except grasshoppers are not suitable for Islamic belief [16, 18]. It was determined that the increase in positive behaviour as a result of the trainings was 30.7% due to religious beliefs.

In Western countries, insects are not included in the nutrition culture, climate conditions are predisposed to agriculture and animal husbandry, welfare level and belief. For example, it has increased its acceptability as a new trend to be seen as a factor that prevents the wasteful consumption of "waste-free kitchens" [39, 40]. According to these results, it is seen that the majority of the participants are influenced by their beliefs that they do not accept edible insects as food and can be used as an alternative. The edible insect trend can be seen as an alternative to basic food and meat by consumers in different geographical regions but for our country, more detailed studies are needed when measuring the situation and attitude.

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Analysis of Different Reallocation Results in Land Consolidation Project

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Abstract: The most important, complex and time-consuming process of land consolidation is known as the reallocation phase. Reallocation processes in land consolidation projects in Turkey is made according to farmer preferences (interview). Besides, the optimization studies based on the mathematical models for the reallocation process in many scientific researches in addition to reallocation model based on interview have been conducted. But, because there isn't a precise mathematical model for the reallocation process, many different solutions have been suggested.

In this study, importance of reallocation in land consolidation and interview-based and block priority-based reallocation models has been described. Also, the results of the block priority-based reallocation model that makes land reallocation by being take into account respectively the largest parcels belong to the farmers have been obtained. The results which are obtained from the block priority-based reallocation model has been compared with the results which are obtained from the interview-based reallocation model. In the consolidation area of the Bogazici neighbourhood (Kocanlı-Aydin-Turkey), previously the number of cadastral parcels were 74. The number of this parcels according to the block priority-based reallocation model that is applied in this study have decreased to 50. Average parcel size was 1.25 hectares before consolidation in this region. Average parcel size has increased to 1.44 hectares according to the interview-based reallocation model and to 1.72 hectares according to the block priority-based reallocation model.

Keywords: Land consolidation, reallocation, the interview-based reallocation, the block priority-based reallocation

INTRODUCTION

Land consolidation is a necessary study in order to modernize rural areas, make economically a livable place and facilitate the environmental management ^[6,7,8,1,2]. This process can be realized that economic, environmental and social factors are considered versatile ^[4,2]

Block reallocation that is the most important, complex and a time-consuming part of land consolidation studies consists of two sections ^[3].

In block reallocation stage of land consolidation studies, after being passed road and irrigation network in the project area, cadastral parcels are placed as areal on land pieces, that is block, at which road and irrigation network surround according to progress payments by taking into account qualification of the soil. After this placement, regular parcels are created as a graph according to the shape of the blocks; and these are given to owners of farmers. The reallocations and new parcels should be created as equal and in a fair way in terms of owners of farmers. Otherwise, it will be continuously object to the project, satisfaction of farmers may not provide, and the project will be accepted. When it is viewed from this angle, it can be said that block reallocation is the most delicate phase of land consolidation and it has to be care to block reallocation ^[5].

In this study, it was investigated that the block priority-based reallocation model that is made by being take into account respectively the largest parcels belong to the farmers could be applied. land consolidation project of Bogazici neighborhood (Kocanlı-Aydin-Turkey) has been selected as the project area. Results of block priority-based reallocation model with results of the traditional method that is known as interview-based reallocation model were compared with each other according to average parcel size with the number of parcels and shares.

MATERIAL AND METHODS

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According to Agrarian Reform Law in accordance with regulation of land on the irrigation areas with number 3083, the block reallocation is made according to interview-based reallocation model in land consolidation projects. In this study, the block reallocation has been made according to interview-based reallocation model and block priority-based reallocation model.

Description of Application Area

Boğaziçi neighborhood is the region belonging to Koçarlı county of Aydın province. Boğaziçi neighborhood is away 17 km from Aydın province and is away 15 km from Koçarlı county. Here's altitude is 40 meters. It is influenced by of the Mediterranean climate. A total of 217 people exist in this neighborhood.

The area of land consolidation project that is made for Boğaziçi neighborhood is 92.28 hectares. There are 101 farmers, so farmers, and 74 cadastral parcels in the consolidation area (Figure 1). 33 pieces of this cadastral parcels are jointly owned parcel. The average size of the cadastral parcels is 1.25 hectares.

The rate of participation share to the joint facilities has been calculated as 0.017637%. With reallocation based on interview that is made in Bogazici neighborhood, the number of new parcels which are created in 10 blocks is 60 (Figure 2a). After the reallocation is made according to model based on interview, the average size of consisting parcels has increased to 1.44 hectares. With the reallocation that is made according to block priority-based model in Bogazici neighborhood, the number of new parcels which are created in 10 blocks is 50 (Figure 2b). The reduction in the rate of new parcels which occur with this reallocation are 32%.



Figure 1. The cadastral status of Boğaziçi neighborhood



Figure 2. Parcelation plans **a)** According to the interview-based reallocation model **b)** According to the block priority-based reallocation model

In the block priority-based reallocation model, the new parcels of 83 farmers has been allocated from the block which the largest parcel is located in. Also, there are farmers which have only to 1 parcel in the block. While some of the blocks has been covered in full, some of them has filled excessively. Therefore, the parcels could not be given to all farmers from the block in which the largest parcel is located. The new parcels of 9 farmers has been given from the block in which second from the largest parcels belonging to them is located. The new parcels of 9 farmers which remain has been given from different blocks. With the model, the rate that The parcels are given to the farmers from the block in which the largest parcels of the farmers is located is 82% according to the number of the farmers. After the reallocation is made according to the block priority based model, the average size of consisting parcels has increased to 1.72 hectares.

RESULTS

Interview-based reallocation model and block priority-based reallocation model have been examined in terms of the number of parcel, the average size of parcel, the number of share, the farmers, and situations with owners of other farmers being close relatives of owners of farmers.

The Number of Parcel

In the area where the research is carried out, the old and new cases of parcels belong to the farmers in terms of the number of parcel are shown in Table 1. The rate of decline in number of parcel is 19% in interview-based reallocation model and is 32% in block priority-based reallocation model. It indicates that block priority-based reallocation model model is a more preferable model in terms of reduction of the number of parcel.

Table 1. Examination of the models in terms of the number of parcels

The Size of Parcel (Decares)	Cadastral Status	Interview-Based Reallocation Model	Block Priority-Based Reallocation Model
	The Number of Parcel	The Number of Parcel	The Number of Parcel
0-5	20	8	7
5-10	20	19	16
10-20	21	25	20
20-30	9	6	5
30+	4	2	2
Total	74	60	50

Before land consolidation, the average number of parcels per enterprise is 0.73. While this number decreased to 0.59 according to interview-based reallocation model, it decreased to 0.50 according to block priority-based reallocation model.

The Average Size of Parcel

The average sizes of parcels belonging to the study area are seen in Table 2.

Table 2. The average sizes of parcels of the reallocation models

The Average Size of Parcel	Area (m ²)	Increase Percentage (%)
In the old statu	12500	-
Interview-based reallocation model	14400	15.2
Block priority-based reallocation model	17200	37.6

The difference between the growth rates of parcels is 22.4% according to these two models (Table 2).

Investigation in Terms of the Number of Shares of the Reallocation Methods

Table 3. The number of jointly owned parcels occurred with the reallocation methods

The Number of Share in Parcel	The Number of Jointly Owned Parcel		
	Cadastral	Interview-Based Reallocation Model	Block Priority-Based Reallocation Model
1	42	33	23
2	7	6	13
3	9	7	4
4	1	5	6
5	4	5	2
6	2	1	1
7	8	1	1
8	-	1	-
11	1	-	-
15	-	1	-
The number of jointly owned parcel	32	27	27
Total	74	60	50

The number of jointly owned parcels were 32 before the reallocation (Table 3). After the reallocations that is made block priority-based and interview-based, the number of jointly owned parcels decreased to 27.

The Investigation in Terms of Farmer of the Reallocation Results

The four farmers have been selected in the application area to constitute the examples. The number of cadastre and the number of parcel which occurs with interview-based reallocation and block priority-based Reallocation belonging to these farmers are shown in Table 4.



Figure 3. The status of the cadastral parcels (a), its new parcels which occur with interview-based reallocation (b) and its new parcels which occur with block priority-based reallocation (c) belonging to the farmer whose number is 17

Table 4. The number of new parcels on the basis of farmers.

Farmer Number	Surname-Name	The Number of Cadastre	The Number of Parcel in Interview-Based Reallocation	The Number of Parcel in Block Priority-Based Reallocation
17	Çetin Ali	8	3	1
44	Kaya Hafize	5	2	1
72	Paşa Kamil	3	1	1
88	Güner Tuncel	6	3	1

The status of the cadastral parcels and its new parcels which occur with interview-based reallocation and block priority-based reallocation belonging to the farmer whose number is 17 are shown in Figure 3.

Evaluation of Situations with Owners of Other Farmers Being Close Relatives of Owners of Farmers

Owners of farmers would like to have in the same block with their close relatives. This preference has been fulfilled in interview-based reallocation method. Whereas, This preference has not been fulfilled in block priority-based reallocation method. This situation may be accepted as disadvantage of block priority-based reallocation method.

CONCLUSION

According to the results of the reallocations which are obtained, when the number of parcels and the number of shares which occur after the reallocation and the average number of parcel and the average size of parcel per farmer are commentated in terms of the number of parcels which are given to farmer, it has been shown that block priority-based reallocation method gives to more successful results. But, when it is commentated that owners of farmers would like to have in the same block with their close relatives, interview-based reallocation method has given to more successful results according to block priority-based reallocation method.

If the block priority-based reallocation method can fulfill to the requests, which are in the same block with their relatives, of farmer owners during the reallocation process, that it will be reached to more successful results is thought. Even if the reallocation studies are made according to interview-based reallocation method in practice, that preliminary reallocation studies is done according to block

priority-based reallocation method will accelerate the studies and will increase the satisfaction of farmers before the interview studies does not start.

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Statical Analysis of Infilled Frames

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Abstract: It is known that infill walls considerably change the behaviour of frames under horizontal loads. However, about this subject, there were not enough knowledge and experience accumulations compared with some other subjects in structural analysis. In order to contribute to the behaviour of infilled frames, a series of experiments carried out under statical loads which were applied in the diagonal direction to the infilled samples having various conjunctions and thicknesses and framed with steel profiles. During the experimental research, the decrease in the horizontal rigidity caused by the separation and sliding between the frame and the infill should be taken into consideration. It was known from the previous researches that after the frame separated and slid, the infill wall works like a compression bar; the experiment results obtained from this study also confirmed this fact. The properties of the “equivalent compression bar” that represents the infill wall were studied to be designated due to the experimental data and compared with the values suggested in the literature. Experimental researches constitute the basis of the study.

INTRODUCTION

The spaces of the load-carrying frames were filled with brick, concrete, briquet, etc. in the vertical plane due to the aim of usage formed from architectural concept. The walls formed by this way changed the load-carrying frame systems to the infilled frame systems.

Although the weight of the infill wall was given as a load on to the frame for vertical loads in the calculations of this type of load-carrying frames, because of the reasons of complexity and difficulty in the calculation of infilled system, not having a reliable and practical calculation method, etc., generally, the influences of the infill walls to the behaviour of the structures under vertical and horizontal loads were neglected in the calculations. This neglect can be in favour of safety or sometimes bring great mistakes and unnecessary structural arrangements and details. The experimental studies about infilled steel frames has begun with Benjamin and Williams^[2,3] and continued with the studies of Polyakov^[1], Holmes^[5], Smith and Carter^[7,8,9], Smolira^[10], Fiorata^[11], Ersoy^[13], Koken^[17], Karaduman^[16,18,20,23], Kaltakci^[19,26], Nezhad^[27], Lila^[21], Kaltakci and Koken^[22], Skafida^[24] also had experimental studies. Unfortunately, the positive and negative effects of infill walls on structural behaviour cannot be introduced clearly and a valid mathematical model cannot be established yet. In all of these works the infill wall was idealized as “equivalent compression bar”.

But now, how the infill walls effect the behaviour of the structural system and in what degree they contribute were not explained clearly and reliable calculation models could not be developed. For this reason, generally, however the infilled frames are more strengthful and rigid than the empty frames, the completed studies are in the early stage of the development and there could not be formed a standard for the calculation of infilled frames.

Because of the frames being under horizontal loads and making horizontal displacements, while it was being waited to have tensile strength through one diagonal of the infill walls, there only occurs diagonal compression because of the infill wall being separated from the frame in the tensile region. For this reason, the representation of the effect of the infilled frame's behaviour with an “effective” compression bar lying along the diagonal, can reflect the real behaviour so closely. Here, the important thing is to determine the mechanical properties of the compression bar in terms of the properties of the infill wall.

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MODELLING OF THE FRAME

Analytical Model

The frame model being chosen as the equivalent infilled frame was shown in Figure 1. The cross-sectional and mechanical properties of the frame were subscripted with “c”; there were shown effective width of the equivalent compression bar with “w” and its length with “d”. In the equivalent frame model, there are assumptions of the compression bar being tied to the frame with the joint and it will transfer normal force only and these should be taken into consideration.

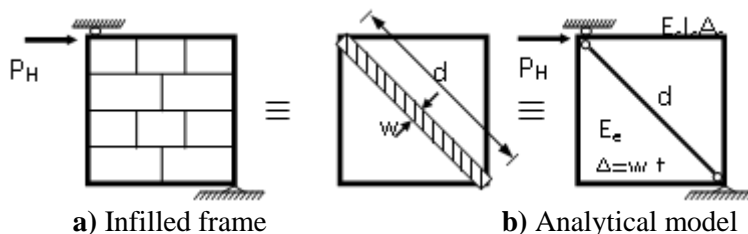


Figure 1. Analytical model of infilled frame system.

The modulus of elasticity of elastic homogeneous material equivalent to infill

The equivalent modulus of elasticity of effective linear homogeneous infill material which is equivalent to the infill, was calculated as in the following and used in the model of equivalent compression bar.

The cross-section of the infill wall formed from “plaster + brick” and had a unit width given as in the following.

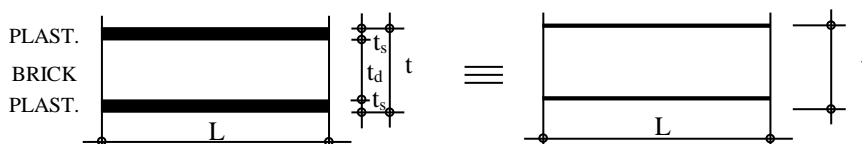


Figure 2. Equivalent wall material

In the explanation, modulus of elasticity is shown with “E” and the thickness with “t” and there were used “e” subscript for equivalent infill wall and “s” subscript for plaster (Figure 2); the modulus of elasticity of the wall with thickness “t” was calculated by $E_e = (2E_s t_s + E_d t_d) / t$.

EXPERIMENTS

Members of the experiments

The NPU120, NPU140, NPU160 profiles were chosen as frame element in the series of infilled steel frames which were prepared in plastered and non-plastered conditions with various geometries, the frame lengths (L) were changed by fixing the frame heights (h) constant. Horizontal-holed bricks were used having dimensions of $19 \times 18.5 \times 8.5$ cm. and $19.5 \times 18.5 \times 13$ cm and Cimentas-air holed bricks having dimensions of $60 \times 25 \times 10$ cm. as the infill material. For wall masonry cement mortar were used in the horizontal-holed brick wall, special bond glue in the air-holed brick wall and rubble mortar for plastering. The contribution of plaster thickness to horizontal rigidity was also another parameter used by this study.

The Program of the experiments

The infilled frame samples which were formed by changing their dimensions were forced along their diagonal directions and their behaviour types were established and evaluated till the failure of the infilled frame.

The angle (θ) between the applied diagonal compression force and the horizontal of the frame changes according to the (h/L) ratios; this situation agrees with the application. In the experiments, having 7 samples in each series there were tested 21 samples in 3 series including one empty frame, 3 infilled and 3 infilled+plastered frames in various dimensions.

In the experiments, in the increasing load levels, the diagonal displacements and/or shape deformations of the samples were measured according to the type of the experiment and cracking load, displacement and cracking type were determined; until the infill wall of the structure cracked and failed, the experiment continued by reading the loads and displacements at definite levels. The graphics of horizontal load-horizontal displacement for these values were drawn in Figure 3.

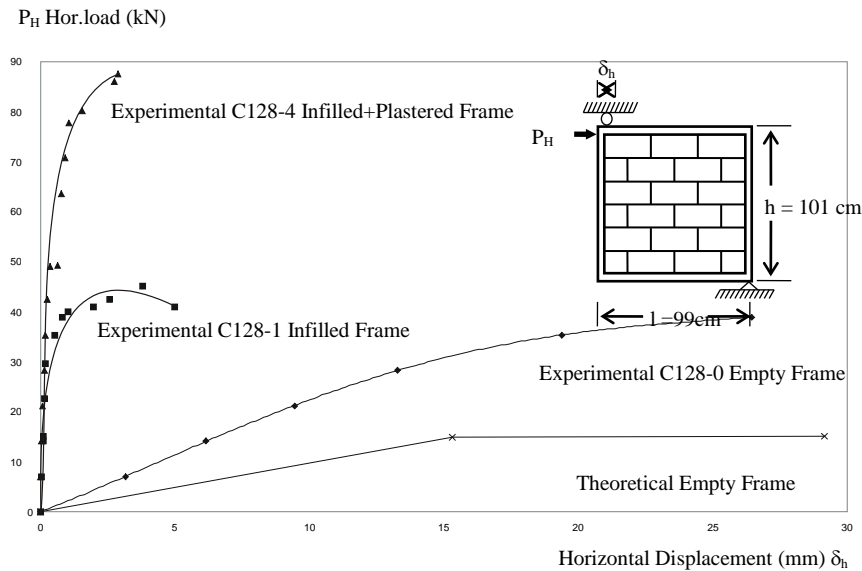


Figure 3: Horizontal load-horizontal displacement curves of test samples C128-0, C128-1, C128-4

Equivalent Compression Bar

The “w” thickness of the equivalent compression bar can be determined by the samples used in the experiment;

1. Equating the results of the finite element model and compression bar carrying frame model;
2. Investigating what the equivalent compression bar’s thickness will be in order to obtain the same displacement which was measured under the applied load in the experiment and in the frame model with compression bar under the same load.

Here, following the second way the “w” equivalent compression widths and this equivalent width’s ratios to the bar length “w/d” were given in Table 1.

Table 1. Cross-Section Properties of Equivalent Compression Bar

Exper. Mem. No	Horizon. Load P_H (kN)	Horizon. Disp. δ_H (mm)	X-sectional Area of Equivalent Bar A (m ²)	Thickness of Infill t (m)	Width of the Equivalent Bar w (m)	Exper. Obtained w/d
C128-1	7.07	0.03	0.07	0.085	0.82	0.58
C128-2	7.66	0.08	0.085	0.085	1.0	0.62
C128-3	8.09	0.042	0.11	0.085	1.29	0.75
C128-4	7.07	0.05	0.11	0.12	0.91	0.62
C128-5	7.66	0.055	0.10	0.12	0.83	0.52
C128-6	8.09	0.066	0.09	0.12	0.75	0.43
C1413-1	7.07	0.05	0.125	0.135	0.92	0.62
C1413-2	7.77	0.07	0.095	0.135	0.70	0.43
C1413-3	8.19	0.26	0.026	0.135	0.19	0.11
C1413-4	7.07	0.037	0.150	0.165	0.91	0.61
C1413-5	7.77	0.09	0.065	0.165	0.39	0.24
C1413-6	8.19	0.159	0.038	0.165	0.23	0.13
C1610-1	6.69	0.17	0.08	0.10	0.8	0.56
C1610-2	7.66	0.24	0.055	0.10	0.55	0.33
C1610-3	8.09	0.14	0.10	0.10	1.0	0.55
C1610-4	6.69	0.057	0.145	0.13	1.11	0.77
C1610-5	7.66	0.088	0.096	0.13	0.75	0.41
C1610-6	8.09	0.09	0.10	0.13	0.77	0.43

In the equivalent compression bar approach which is simple however giving good results and suggested by Smith ^[8], $w/d = 0.20 \sim 0.25$ was averagely projected. These ratios were about approximately 0.35-0.60 in the works of some researchers Smith and Carter ^[9] and Mainstone^[14]. For calculating this ratio Smith and Carter ^[8] suggested the following relation,

$$w / d = 0.16 (\lambda_h \cdot h)^{-0.3} \sin 2\theta \quad (\text{Equation 1})$$

In this relation, $\lambda_h \cdot h$ which is named as “rigidity parameter” and given in the following, explains the rigidity of the frame in response to the infill.

$$\lambda_h \cdot h = \left[\frac{E_I \cdot t \cdot \sin 2\theta}{4E \cdot I \cdot h'} \right]^{1/4} \quad (\text{Equation 2})$$

In the dimensionless rigidity parameter, E_I represents the modulus of elasticity of the infill, “ t ” the thickness of the infill wall, “ E ” the modulus of elasticity of the frame, “ I ” the moment of inertia of the column and “ h ” the height of the infill.

Mainstone^[14] who used the same parameter, suggested the following relation for the previously mentioned ratio;

$$w / d = 0.175 (\lambda_h \cdot h)^{-0.4} \quad (\text{Equation 3})$$

In order to determine the w/d ratio related with the experimental researches, there was also reached the following relation that includes the rigidity parameter by discarding some of the extreme values determined in the experiments whose program has been given previously and made on the

plastered and unplastered infilled frame samples in the Selcuk University Engineering – Architectural Faculty Structure Laboratory ^[15].

$$w/d = 0.52 (\lambda_h \cdot h)^{0.005} \sin 2\theta \quad (\text{Equation 4})$$

The theoretical and experimental values determined by this relation were given comparatively in Table 2 and Figure 4 with the values of Smith and Carter ^[9] and Mainstone ^[14].

Table 2. The comparison of theoretical and experimental (w/d) values

Exper. Member No	Rigidity Parameter $\lambda_h \cdot h = \left[\frac{EI \cdot t \cdot \sin 2\theta}{4E \cdot I \cdot h'} \right]^{1/4}$	Theoretical According to Smith & Carter w/d	Theoretical According to Mainstone w/d	Experimental w/d
C128-1	0.049847	0.39	0.58	0.75
C128-2	0.049657	0.39	0.58	0.62
C128-3	0.049226	0.37	0.58	0.82
C128-4	0.058642	0.37	0.54	0.62
C128-5	0.058418	0.37	0.55	0.52
C128-6	0.057911	0.36	0.55	0.43
C1413-1	0.053254	0.39	0.57	0.62
C1413-2	0.052969	0.38	0.57	0.43
C1413-3	0.052441	0.36	0.57	0.11
C1413-4	0.058166	0.38	0.55	0.61
C1413-5	0.057854	0.37	0.55	0.24
C1413-6	0.057277	0.35	0.55	0.13
C1610-1	0.040768	0.42	0.63	0.56
C1610-2	0.040668	0.41	0.63	0.33
C1610-3	0.040315	0.40	0.63	0.55
C1610-4	0.047650	0.40	0.59	0.77
C1610-5	0.047533	0.39	0.59	0.41
C1610-6	0.047120	0.38	0.59	0.43

As seen in Figure 4, the theoretical and experimental results obtained by the laboratory studies are in harmony with Smith and Carter ^[9].

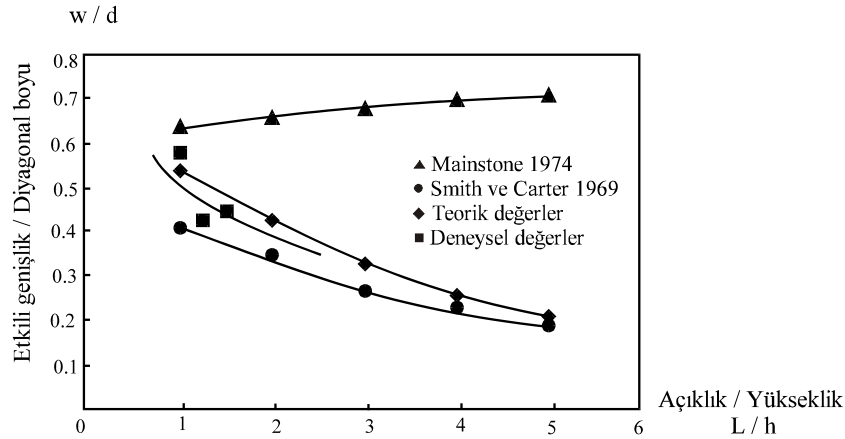


Figure 4. The comparison of the determined values with the literature

RESULTS

The infill walls increase the rigidity of the frames in considerable amounts. The increase in rigidity having various values could not be undervalued in each of the following three phases, (I) In the phase of the behaviour of the linear elastic material (II) After the wall cracks, and (III) The failure phase

The neglect of infill walls in the structural solutions (statical calculation) is a widespread application in structural engineering. However, it is also known that the structures designed like this have sufficient performances under their design loads. The present conflict can be explained by the concept that is in application and a good index for structural dimensioning. The sufficiency of the result does not show that the modelling is adequately right. However, it is difficult to take into consideration the contribution of the infill walls to the structural strength and rigidity in adequate measures. Although the present capacities of the computers give opportunity to these like analyses, these like calculations are so difficult compared with the standard projections. In that case, it is useful to continue with the equivalent compression bar approach at least “for the time being” for taking into consideration the contribution of the walls. In this approach’s literature, there exist suggestions that project to take the equivalent compression bar’s width as 0.1 to 0.4 times of the diagonal length of the compression bar ^[9,14]. Due to the experiment results made here, it will be a sufficient and cautious approach to take this ratio as 0.20.

Plaster of good quality, increases the activity of the infill wall structurally. It is clear for the plaster to be effective that its adherence with the wall and the frame should be well; especially at the sides plaster should not exceed the frame. In the experiments carried out here, there was seen that the plaster exceeding the frame, has been easily broken off in big parts and thrown away yet in the cracking phase.

In the infilled frames, it was observed that the tensile diagonal of the first cracks generally take place at the frame-wall spaces of the end zones. But, it was seen that the cracks occurred at this region did not change the rigidity of the frame nearly never and the load-displacement curve continued until there had been seen body cracks on the wall or/and shear or compression cracks at the end of the compression diagonal.

Relative increase of the frame rigidity increases the length of the frame which is in contact with the infill wall during the frame’s horizontal displacement. In order to get the expected benefit from the infill wall, the rigidity of the frame should be adequate, and the failure of the frame should not occur before the failure of the infill wall.

All the experimental studies performed here were carried out under statical loads. However, for both seismic loads and wind loads, the infill walls would be subjected to cyclic forcings. For this reason, the effective width of the compression diagonal should be taken more cautiously than the statical load conditions. Likewise, in the literature, the suggestions related with the compression diagonal width are below the ones determined with the statical experiments.

Again, from the literature, it is known that infill walls provide the structure from more serious damages by exhausting or decreasing the structure’s kinetic energy in a small period with the seismic energy exhausted in the cracking and failure phases. In other words, dividing walls practically contribute to the structure positively in the both elastic (small earthquakes) and plastic behaviour (big earthquakes) of the structure. The important thing is to estimate the wall contribution with a right and safe approach by not going beyond the bounds.

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