I.E.D. ESCUELA NORMAL SUPERIOR

GUÍA TERCER PERIODO ACADÉMICO 2020

ASIGNATURA/AS: _______QUIMCA_________________

NOMBRE DEL DOCENTE: **IVÁN TÉLLEZ LÓPEZ.**	**GRADO:** **10**	**PERIODO:** **3**	**FECHA INICIO:** **3 DE AGOSTO 2020**	**FECHA DE FINALIZACIÓN Y ENTREGA DE TRABAJOS:** **1 AVANCE: SEMANA DEL 10 AL 14 DE AGOSTO** **2 AVANCE: SEMANA DEL 17 AL 21 DE AGOSTO** **3 AVANCE: SEMANA DEL 1 DE SEPTIEMBRE AL 4 DE SEPTIEMBRE** **FECHA MAXIMA DE ENTREGA DE LA GUIA COMPLETA.** **11 DE SEPTIEMBRE 2020** **RETROALIMENTACIÓN DEL APRENDIZAJE 14 AL 25 DE SEPTIEMEBRE.**

ESTANDAR BÁSICO DE COMPETENCIA o DBA:	**NÚCLEO PROBLÉMICO:**
Uso la tabla periódica para determinar propiedades físicas y químicas de los elementos. Realizo cálculos cuantitativos en cambios químicos	¿CÓMO PUEDO CONTRIBUIR PARA DISMINUIR LA CONTAMINACIÓN ATMÓSFÉRICA EN NUESTRO PLANETA EN EPOCAS DE AISLAMIENTO SOCIAL?

OBJETIVO DE LA ACTIVIDAD:	**HABILIDADES ESPECÍFICAS QUE VA A DESARROLLAR EL ESTUDIANTE:**	**INTEGRALIDAD, ACORDE AL MODELO PEDAGÓGICO INTEGRADOR CON ENFOQUE SOCIO CRÍTICO**
• Identificar cada uno de los grupos funcionales dentro de la química inorgánica para poderlos reconocer en contexto.	**Identifico e interpreto** las propiedades físicas y químicas que caracterizan a óxidos, Ácidos, hidróxidos, sales e hidruros usando las diferentes reglas para nómbralos.	✓ **SOCIALES**: Líneas de tiempo sobre el estudio de las sustancias químicas y sus reacciones.

• Comprender y analizar la tabla periódica teniendo en cuenta clasificación de los elementos y a partir de ella poder construir los compuestos que constituyen la química inorgánica. • Analizar cómo estos compuestos pueden favorecer o desfavorecer a la contaminación ambiental del planeta y que se ha modificado durante los tiempos de pandemia		✓ **LENGUA CASTELLANA**: Lectura crítica de textos argumentativos y construcción de un escrito sobre la historia de la nomenclatura química.

NÚCLEO TEMÁTICO	RUTA METODOLÓGICA	RECURSOS	NIVELES DE DESEMPEÑO
Nomenclatura química de compuestos inorgánicos - Símbolos Químicos y formulas Químicas. – Estados de oxidación. - Funciones químicas y grupos funcionales de la química inorgánica	1. DIALOGO DE SABERES. Previos del estudiante grupo familiar: (DEL 10 AL 14 DE AGOSTO) ¿Cuál es la historia de la Nomenclatura Química? ¿Cómo se han clasificado los compuestos químicos a través de la historia (Haga una línea de tiempo) ¿Qué es la IUPAC? ¿Cómo se clasifican los compuestos químicos por su peligrosidad? ¿Cómo se clasifican los Residuos sólidos y líquidos (Basuras)? 2. PROCESOS DE DECONSTRUCCIÓN Y CONSTRUCCIÓN DE CONCEPTOS. (DEL 17 AL 21 DE AGOSTO) Hacer mapas conceptuales de: ¿qué es?, ¿cuáles son sus propiedades? y ¿cómo se nombran los: ¿Óxidos, Ácidos, Bases, Sales e Hidruros? (Un mapa para cada función química) Elaborar un cuadro donde se expliquen cuáles son las reglas que se deben tener para nombrar los óxidos, ácidos, bases, sales e hidruros de acuerdo con las normas IUPAC vigentes	• Lápices • Libros • Videos • Internet • Esferos • Marcadores • YouTube • Química 10°. Educar editores de Julio Cesar Poveda Vargas. • Taller de nomenclatura química Inorgánica elaborado por el Maestro Iván Téllez López (Anexo 1)	**SÚPERIOR** Identifico los elementos de la tabla periódica, reconozco las fórmulas químicas y con ellas Diferencio entre un oxido, un ácido, una base, una sal y un hidruro. Busco información en diferentes fuentes, escojo la pertinente y doy el crédito correspondiente. **ALTO** Identifico los elementos de la tabla periódica, reconozco algunas fórmulas químicas y con ellas establezco algunas diferencias entre un oxido, un ácido, una base, una sal y un hidruro.

	Hacer un resumen sobre el texto Solid Waste (Anexo 2) Este se trabaja durante todo el periodo académico y se entrega en la última semana del periodo (11 de septiembre) (Actividad integrada con Ingles) **3. ESTRUCTURACIÓN DEL NUEVO CONOCIMIENTO:** Del documento Anexo (Taller de Nomenclatura Inorgánica) Actividad permanente durante todo tercer periodo académico. FECHA DE ENTREGA 11 DE SEPTIEMBRE DE 2020 Semanalmente se debe realizar un paquete de ejercicios iniciando con el paquete número 1. Estos a su vez, cada semana serán trabajados en clase por el maestro y retroalimentados de acuerdo con el avance de los estudiantes. **4. APLICACIÓN DE SABERES.** Diseñe una estrategia en su casa para la separación y reutilización de residuos sólidos (documente la experiencia por medio de fotografías) Con elementos de su casa muestre 3 óxidos, 3 ácidos, 3 sales, 3 bases y 3 hidruros, clasifíquelos sobre su mesa del comedor colóqueles un rotulo indicando cada uno que es y a que grupo pertenecen y luego fotografié la experiencia. (documente la experiencia por medio de fotografías FECHA DE ENTREGA 11 DE SEPTIEMBRE DE 2020		Busco información en diferentes fuentes, escojo la pertinente y doy el crédito correspondiente. **BÁSICO** En ocasiones comprendo la relación de la tabla periódica con los compuestos que se pueden formar. Me es difícil construir formulas químicas e identificar a que grupo funcional corresponde cada una de ellas. Baso mi trabajo solo en una o dos fuentes de información, lo que me impide lograr decantar cual es la de mejor calidad y a veces no referencio de donde saque esta información. **BAJO** Se me dificultad reconocer y comprender los elementos de la tabla periódica. No puedo reconocer las fórmulas químicas de cada grupo funcional

			Se me dificulta diferenciar entre un oxido, un ácido, una base, una sal y un hidruro. BAJO: no logro comprender la importancia de buscar información en diferentes fuentes, para escoger la más pertinente y dar el crédito correspondiente.

AJUSTES RAZONABLES PARA ESTUDIANTES ATENDIDOS POR INCLUSIÓN:

Las actividades que se presentan en esta guía pueden ser desarrollas sin ninguna dificultad, contando con el apoyo familiar y asesoría personalizada del docente. En todos los casos los estudiantes pueden comunicarse a cualquier hora del día con los estudiantes que lo necesiten.

OTROS RECURSOS QUE SE PUEDEN UTILIZAR

Sobre historia de la nomenclatura: http://thesciencewatcher.blogspot.com/2013/09/breve-historia-de-la-nomenclatura-y.html
Clasificación de los compuestos químicos por su peligrosidad https://www.unirioja.es/servicios/sprl/pdf/curso_clasificacion_pq.pdf
Como se nombran los compuestos inorgánicos http://www.ucv.ve/fileadmin/user_upload/facultad_agronomia/Propedeutico/2014/GuIa_de_Estudio_PropedEutico_QuImica.pdf
Como se nombran los óxidos https://bsantander11.webnode.com.co/news/como-se-nombran-los-oxidos/

Anexo 1. **Taller de Nomenclatura Inorgánica elaborado por el Maestro Iván Téllez López**
Anexo 2. Solid Waste

FORMAS DE PRESENTACIÓN Y ENTREGA DE TRABAJOS:

MODALIDAD DE PRESENTACIÓN Y ENTREGA DE TRABAJOS: (consulta las fechas de finalización y entrega de trabajos en la parte superior derecha)

1. Los trabajos se realizan en el cuaderno (letra legible), de manera organizada, letra legible y se fotografía cada hoja del cuaderno y enviar como documento en PDF al correo electrónico kenytellez@gmail.com

2. Para los casos que por fuerza mayor no puedan ser enviados por correo electrónico (Previo acuerdo con el maestro) se enviaran las imágenes por WhatsApp previamente organizadas, y con un adecuado enfoque para que puedan ser leídas.

3. Los avances de la guía se revisarán en las clases correspondientes conforme a las fechas acordadas (parte superior derecha de esta guía), es necesario aclarar que se tendrá toda la semana asignada para la entrega de avances y constituirá un aspecto muy importante para evaluar su puntualidad y entrega.

4. Recuerde que los canales oficiales de comunicación con el maestro son: correo electrónico kenytellez@gmail.com o WhatsApp: 3102135743

AUTOEVALUACIÓN. (A manera de auto reflexión)

¿Seguí las indicaciones dadas por mi maestro de manera correcta? Si _____ No _____
¿Fui respetuoso al comunicarme con mi maestro y compañeros? Si _____ No _____
¿Entregué mis trabajos en las fechas establecidas? Si _____ No _____
¿Elaboré mis trabajos con calidad y exigencia? Si _____ No _____
¿Utilicé adecuadamente la herramienta de WhatsApp cumpliendo los acuerdos de respeto y horarios pactados desde su creación? Si _____ No _____
¿Estuve pendiente de la información, instrucciones y explicaciones dadas por mi maestro a través de los grupos de WhatsApp? Si _____ No _____
¿Conté con el apoyo de mi familia para el desarrollo de las actividades? Si _____ No _____
¿Me apoyé con mis compañeros frente a las dudas o inquietudes que pueda llegar a tener? Si _____ No _____
¿Qué dificultades se me presentaron durante este tercer período? ____
¿Cómo las superé? ____
¿Qué nuevos aprendizajes adquirí? Menciona mínimo tres.
Considero que mi valoración es _______________ Menciona tres argumentos que justifiquen tu valoración
____
____
____

COEVALUACIÓN: (A manera de auto reflexión)

¿El o La estudiante siguió las indicaciones dadas por su maestro de manera correcta? Si _____ No _____
¿El o La estudiante fue respetuoso/a al comunicarse con su maestro y compañeros? Si _____ No _____
¿El o La estudiante entregó sus trabajos en las fechas establecidas? Si _____ No _____
¿El o La estudiante elaboró sus trabajos con calidad y exigencia? Si _____ No _____
¿El o La estudiante utilizó adecuadamente la herramienta de WhatsApp cumpliendo los acuerdos de respeto y horarios pactados desde su creación? Si _____ No _____

¿El o La estudiante estuvo pendiente de la información, instrucciones y explicaciones dadas por su maestra a través de los grupos de WhatsApp? Si _____ No _____
¿El o La estudiante contó con el apoyo de su familia para el desarrollo de las actividades? Si _____ No _____
¿El o La estudiante se apoyó con sus compañeros frente a las dudas o inquietudes que pueda llegar a tener?
¿Qué dificultades presentó el o la estudiante durante este tercer período? ¿Cómo las superó?
¿Qué nuevos aprendizajes adquirió el / la estudiante? Menciona mínimo tres.
La persona que acompañó mi proceso de aprendizaje considera que mi valoración debe ser ____________________ Ella o él debe mencionar tres argumentos que justifiquen su respuesta.____
____
____

HETEROEVALUACIÓN:

Los siguientes parámetros serán valorados y evaluados al interior de la asignatura durante todo el segundo período académico:

1. Asistencia a las sesiones de clase de manera virtual (WhatsApp) o Zoom en algunas sesiones
2. Participación activa dentro de las sesiones de clase.
3. comunicación asertiva y respetuosa.
4. Seguimiento adecuado de indicaciones
5. Puntualidad en la entrega de trabajos
6. Calidad en el desarrollo de las actividades
7. Uso adecuado y asertivo de los canales de comunicación
8. cumplimento de los acuerdos y normas, aprendizaje autónomo, pensamiento crítico, creatividad, interés y responsabilidad.

Vo.Bo DEL COORDINADOR ACADÉMICO Y OBSERVACIONES:

Lyda Yazmin Hernández F.
Coordinadora
Escuela Normal Superior Ubaté

ESCUELA NORMAL SUPERIOR DE UBATE
TALLER DE NOMENCLATURA INORGANICA

Apellidos y Nombres: ____ Curso: ______

Nota: Desarrolle este taller en su cuaderno, copie los cuadros y complete según corresponda, en la parte final haga un cuadro para las tres nomenclaturas de cada formula.

FORMULACIÓN DE QUÍMICA INORGÁNICA.

En su cuaderno llene los cuadros según corresponda.

*Escribe los nombres que faltan en la tabla.

EJERCICIO 1. COMPLETA LA TABLA DE OXIDOS

Fórmula	N. sistemática	N. stock	N. tradicional
F_2O			
I_2O_7			
As_2O_5			
CaO			
Fe_2O_3			
PbO_2			
Al_2O_3			
SnO			
N_2O_5			
Au_20			
TeO_2			
			Óxido aúrico
			Óxido cuproso
		Óxido de selenio (II)	
			Óxido crómico

EJERCICIO 2. COMPLETA LA TABLA

Fórmula	N. sistemática	N. stock	N. tradicional
AuH_3			
LiH			
		Hidruro de plomo (II)	
		Hidruro de plata	
			Fosfina
			Metano
	Trihidruro de arsénico		
N_2O_3			
NO			
	Pentaóxido de dinitrógeno		
	Trióxido de azufre		
			Óxido ferroso
			Hidruro niquélico
PbO_2			
		Óxido de bromo (VII)	
		Hidruro de calcio	

EJERCICIO 3. COMPLETA LA TABLA DE HIDROXIDOS

Fórmula	N. sistemática	N. stock	N. tradicional
$Fe(OH)_3$			
Au(OH)			
$Cr(OH)_2$			
		Hidróxido de talio (I)	
		Hidróxido de mercurio (II)	
	Dihidróxido de cadmio		
			Hidróxido estannoso
K(OH)			
			Hidróxido estánnico
		Óxido de plomo (II)	
			Anhídrido carbónico
		Óxido de platino (IV)	
			Metano
NiH_3			
			Óxido ferroso
Ag(OH)			
H_2Se			
			Ácido bromhídrico

EJERCICIO 4. COMPLETA LA TABLA.

Fórmula	N. sistemática	N. stock	N. tradicional
		Hidruro de calcio	
		Hidruro de estroncio	
		Hidruro de aluminio	
		Hidruro de cobalto (II)	
			Estibina
	----------------------------------	--------------------------------	Ácido clorhídrico
	----------------------------------	--------------------------------	Ácido sulfhídrico
	----------------------------------	--------------------------------	Ácido Iodhídrico
	----------------------------------	--------------------------------	Ácido hipocloroso
	----------------------------------	--------------------------------	Ácido Iodoso
	----------------------------------	--------------------------------	Ácido periódico
	----------------------------------	--------------------------------	Ácido hipofluoroso
	----------------------------------	--------------------------------	Ácido selenioso
	----------------------------------	--------------------------------	Ácido telúrico
N_2O_3			
MgO			
Cl_2O			
			Borano
	----------------------------------	--------------------------------	Ácido permangánico
	----------------------------------	--------------------------------	Ácido metafosforoso
	----------------------------------	--------------------------------	Ácido metaantimónico
	----------------------------------	--------------------------------	Ácido pirofosfórico
	----------------------------------	--------------------------------	Ácido piroantimonioso
	----------------------------------	--------------------------------	Ácido ortofosforoso
	----------------------------------	--------------------------------	Ácido fosfórico

EJERCICIO 5. COMPLETA LA TABLA.

Fórmula	N. stock	N. tradicional
	--------------------------------	Ácido crómico
	--------------------------------	Ácido dicrómico
	--------------------------------	Ácido carbónico
HPO_2	--------------------------------	
H_2SO_4	--------------------------------	
$HClO_4$	--------------------------------	
$HBrO_3$	--------------------------------	
HIO	--------------------------------	
HBr	--------------------------------	
PH_3	--------------------------------	
SbH_3	--------------------------------	
$HBrO_2$	--------------------------------	
H_2SeO_2	--------------------------------	
HI	--------------------------------	
H_2SeO_3	--------------------------------	
	Hidróxido de berilio	
	Hidróxido de niquel (III)	
	Hidróxido de plomo (II)	

EJERCICIO 6. COMPLETA LA TABLA.

Formula	N. stock	N. tradicional
	Cloruro de estaño (IV)	
		Cloruro sódico
	Yoduro de plata	
	Bromuro de cobalto (III)	
	Sulfuro de plomo (IV)	
	Seleniuro de cobre (II)	
	Telururo de mercurio (I)	

EJERCICIO 7. COMPLETA LA TABLA.

Fórmula	Nomenclatura
	Clorato de potasio
	Hipobromito de calcio
	Bromato de estaño (IV)
	Perclorato de mercurio (II)
	Sulfato de calcio
	Hiposelenito de cobre (II)
	Telurito de cobre (I)
	Metarseniato de hierro (III)
	Metantimonito de estaño (IV)
	Pirofosfato de calcio
	Piroarsenito de sodio
	Ortoantimoniato de níquel (III)
	Carbonato de sodio
	Silicato de potasio

Haga la formula de las siguientes sustancias:

1. Óxido de bario
2. Óxido de sodio
3. Anhídrido sulfuroso
4. Óxido de plata
5. Óxido de aluminio
6. Óxido de níquel (III)
7. Óxido de cloro (VII)
8. Óxido nitroso
9. Anhídrido nitroso
10. Hidruro de litio
11. Cloruro de cobalto (III)
12. Hidruro de plata
13. Ácido bromhídrico
14. Ácido sulfhídrico
15. Amoniaco
16. Ácido clorhídrico
17. Peróxido de bario
18. Hidruro de calcio
19. Peróxido de sodio
20. Óxido de estroncio
21. Ácido clorhídrico
22. Cloruro de sodio
23. Fluoruro de calcio
24. Yoduro de plomo (II)
25. Bromuro potásico
26. Arsenamina
27. Sulfuro de bario
28. tricloruro de arsénico
29. Peróxido de litio
30. Sulfuro de hierro (II)
31. Ácido nítrico
32. Ácido carbónico
33. Ácido perclórico
34. Ácido fosfórico
35. Ácido metafosfórico
36. Ácido sulfhídrico
37. Ácido sulfúrico
38. Ácido hipoiodoso
39. Hidruro de magnesio
40. Ácido silícico
41. Hidróxido de calcio
42. Hidróxido de hierro (III)
43. Ácido nitroso
44. Hidróxido de aluminio
45. Bromuro de cobalto (II)
46. Hidróxido de potasio
47. Sulfato de calcio
48. Cloruro de cobalto (III)
49. Nitrito de litio
50. Carbonato sódico
51. Cloruro potásico
52. Sulfuro de zinc
53. Hipoiodito potásico
54. Fosfato cálcico
55. Hidrógeno carbonato potásico
56. Hidrógeno sulfato de litio
57. Peróxido de plata
58. Hidrógeno ortoarseniato de potasio

Del nombre a los siguientes compuestos:

1. BaO
2. Na_2O
3. SO_2
4. CaO
5. Ag_2O
6. NiO
7. Cl_2O_7
8. P_2O_5
9. LiH
10. CaO
11. AgH
12. HBr
13. H_2S
14. NH_3
15. HCl
16. BaO
17. CaH_2
18. Na_2O_2
19. PH_3
20. Cs_2O
21. PbI_2
22. KBr
23. AsH_3
24. BaS
25. $AlCl_3$
26. Al_2S_3
27. Li_2O
28. FeS
29. HNO_3
30. H_2CO_3
31. $HClO_4$
32. H_3PO_4
33. $H_4P_2O_5$
34. HIO
35. H_2S
36. MgH_2
37. H_2SiO_3
38. $Ca(OH)_2$
39. $Fe(OH)_3$
40. HNO_2
41. $Al(OH)_3$
42. KOH
43. $CaSO_4$
44. $Al_2(SiO_3)_3$
45. $CoCl_2$
46. $LiNO_2$
47. Na_2CO_3
48. $Ca_3(PO_4)_2$
49. $KHCO_3$
50. $ZnCl_2$
51. Na_2CO_3
52. HgO
53. $NaOH$
54. CH_4
55. KIO

Solid-waste management

WRITTEN BY
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Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects. The tasks of solid-waste management present complex technical challenges. They also pose a wide variety of administrative, economic, and social problems that must be managed and solved.

sanitary landfill
Bulldozers working on a sanitary landfill.© *SergeyZavalnyuk*

Historical Background

Early waste disposal

In ancient cities, wastes were thrown onto unpaved streets and roadways, where they were left to accumulate. It was not until 320 BCE in Athens that the first known law forbidding this practice was established. At that time a system for waste removal began to evolve in Greece and in the Greek-dominated cities of the eastern Mediterranean. In ancient Rome, property owners were responsible for cleaning the streets fronting their property. But organized waste collection was associated only with state-sponsored events such as parades. Disposal methods were very crude, involving open pits located just outside the city walls. As populations increased, efforts were made to transport waste farther out from the cities.

After the fall of Rome, waste collection and municipal sanitation began a decline that lasted throughout the Middle Ages. Near the end of the 14th century, scavengers were given the task of carting waste to dumps outside city walls. But this was not the case in smaller towns, where most people still threw waste into the streets. It was not until 1714 that every city in England was required to have an official scavenger. Toward the end of the 18th century in America, municipal collection of garbage was begun in Boston, New York City, and Philadelphia. Waste disposal methods were still very crude, however. Garbage collected in Philadelphia, for example, was simply dumped into the Delaware River downstream from the city.

Developments in waste management

A technological approach to solid-waste management began to develop in the latter part of the 19th century. Watertight garbage cans were first introduced in the United States, and sturdier vehicles were used to collect and transport wastes. A significant development in solid-waste treatment and disposal practices was marked by the construction of the first refuse incinerator in England in 1874. By the beginning of the 20th century, 15 percent of major American cities were incinerating solid waste. Even then, however, most of the largest cities were still using primitive disposal methods such as open dumping on land or in water.

Technological advances continued during the first half of the 20th century, including the development of garbage grinders, compaction trucks, and pneumatic collection systems. By mid-century, however, it had become evident that open dumping and improper incineration of solid waste were causing problems of pollution and jeopardizing public health. As a result, sanitary landfills were developed to replace the practice of open dumping and to reduce the reliance on waste incineration. In many countries waste was divided into two categories, hazardous and nonhazardous, and separate regulations were developed for their disposal. Landfills were designed and operated in a manner that minimized risks to public health and the environment. New refuse incinerators were designed to recover heat energy from the waste and were provided with extensive air pollution control devices to satisfy stringent standards of air quality. Modern solid-waste management plants in most developed countries now emphasize the practice of recycling and waste reduction at the source rather than incineration and land disposal.

Solid-Waste Characteristics

Composition and properties: The sources of solid waste include residential, commercial, institutional, and industrial activities. Certain types of wastes that cause immediate danger to exposed individuals or environments are classified as hazardous; these are discussed in the article hazardous-waste management. All nonhazardous solid waste from a community that requires collection and transport to a processing or disposal site is called refuse or municipal solid waste (MSW). Refuse includes garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. Garbage is highly putrescible or decomposable, whereas rubbish is not. Trash is rubbish that includes bulky items such as old refrigerators, couches, or large tree stumps. Trash requires special collection and handling.

Construction and demolition (C&D) waste (or debris) is a significant component of total solid waste quantities (about 20 percent in the United States), although it is not considered to be part of the MSW stream. However, because C&D waste is inert and nonhazardous, it is usually disposed of in municipal sanitary landfills.

Another type of solid waste, perhaps the fastest-growing component in many developed countries, is electronic waste, or e-waste, which includes discarded computer equipment, televisions, telephones, and a variety of other electronic devices. Concern over this type of waste is escalating. Lead, mercury, and cadmium are among the materials of concern in electronic devices, and governmental policies may be required to regulate their recycling and disposal.

electronic waste
Electronic waste in a garbage dump.

Solid-waste characteristics vary considerably among communities and nations. American refuse is usually lighter, for example, than European or Japanese refuse. In the United States paper and paperboard products make up close to 40 percent of the total weight of MSW; food waste accounts for less than 10 percent. The rest is a mixture of yard trimmings, wood, glass, metal, plastic, leather, cloth, and other miscellaneous materials. In a loose or uncompacted state, MSW of this type weighs approximately 120 kg per cubic metre (200 pounds per cubic yard). These figures vary with geographic location, economic conditions, season of the year, and many other factors. Waste characteristics from each community must be studied carefully before any treatment or disposal facility is designed and built.

Generation and storage

Rates of solid-waste generation vary widely. In the United States, for example, municipal refuse is generated at an average rate of approximately 2 kg (4.5 pounds) per person per day. Japan generates roughly half this amount, yet in Canada the rate is 2.7 kg (almost 6 pounds) per person per day. In some developing countries the average rate can be lower than 0.5 kg (1 pound) per person per day. These data include refuse from commercial, institutional, and industrial as well as residential sources. The actual rates of refuse generation must be carefully determined when a community plans a solid-waste management project.

Most communities require household refuse to be stored in durable, easily cleaned containers with tight-fitting covers in order to minimize rodent or insect infestation and offensive odours. Galvanized metal or plastic containers of about 115-litre (30-gallon) capacity are commonly used, although some communities employ larger containers that can be mechanically lifted and emptied into collection trucks. Plastic bags are frequently used as liners or as disposable containers for curbside collection. Where large quantities of refuse are generated—such as at shopping centres, hotels, or apartment buildings—dumpsters may be used for temporary storage until the waste is collected. Some office and commercial buildings use on-site compactors to reduce the waste volume.

Proper solid-waste collection is important for the protection of public health, safety, and environmental quality. It is a labour-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management. Public employees are often assigned to the task, but sometimes it is more economical for private companies to do the work under contract to the municipality or for private collectors to be paid by individual home owners. A driver and one or two loaders serve each collection vehicle. These are typically trucks of the enclosed, compacting type, with capacities up to 30 cubic metres (40 cubic yards). Loading can be done from the front, rear, or side. Compaction reduces the volume of refuse in the truck to less than half of its loose volume.

The task of selecting an optimal collection route is a complex problem, especially for large and densely populated cities. An optimal route is one that results in the most efficient use of labour and equipment, and selecting such a route requires the application of computer analyses that account for all the many design variables in a large and complex network. Variables include frequency of collection, haulage distance, type of service, and climate. Collection of refuse in rural areas can present a special problem, since the population densities are low, leading to high unit costs.

Refuse collection usually occurs at least once per week because of the rapid decomposition of food waste. The amount of garbage in the refuse of an individual home can be reduced by garbage grinders, or garbage disposals. Ground garbage puts an extra load on sewerage systems, but this can usually be accommodated. Many communities now conduct source separation and recycling programs, in which homeowners and businesses separate recyclable materials from garbage and place them in separate containers for collection. In addition, some communities have drop-off centres where residents can bring recyclables.

Transfer stations

If the final destination of the refuse is not near the community in which it is generated, one or more transfer stations may be necessary. A transfer station is a central facility where refuse from many collection vehicles is combined into a larger vehicle, such as a tractor-trailer unit. Open-top trailers are designed to carry about 76 cubic metres (100 cubic yards) of uncompacted waste to a regional processing or disposal location. Closed compactor-type trailers are also available, but they must be equipped with ejector mechanisms. In a direct discharge type of station, several collection trucks empty directly into the transport vehicle. In a storage discharge type of station, refuse is first emptied into a storage pit or onto a platform, and then machinery is used to hoist or push the solid waste into the transport vehicle. Large transfer stations can handle more than 500 tons of refuse per day.

Solid-Waste Treatment And Disposal

Once collected, municipal solid waste may be treated in order to reduce the total volume and weight of material that requires final disposal. Treatment changes the form of the waste and makes it easier to handle. It can also serve to recover certain materials, as well as heat energy, for recycling or reuse.

Incineration

Furnace operation

Burning is a very effective method of reducing the volume and weight of solid waste, though it is a source of greenhouse gas emissions. In modern incinerators the waste is burned inside a properly designed furnace under very carefully controlled conditions. The combustible portion of the waste combines with oxygen, releasing mostly carbon dioxide, water vapour, and heat. Incineration can reduce the volume of uncompacted waste by more than 90 percent, leaving an inert residue of ash, glass, metal, and other solid materials called bottom ash. The gaseous by-products of incomplete combustion, along with finely divided particulate material called fly ash, are carried along in the incinerator airstream. Fly ash includes cinders, dust, and soot. In order to remove fly ash and gaseous by-products before they are exhausted into the atmosphere, modern incinerators must be equipped with extensive emission control devices. Such devices include fabric baghouse filters, acid gas scrubbers, and electrostatic precipitators. (*See also* air pollution control.) Bottom ash and fly ash are usually combined and disposed of in a landfill. If the ash is found to contain toxic metals, it must be managed as a hazardous waste.

Municipal solid-waste incinerators are designed to receive and burn a continuous supply of refuse. A deep refuse storage pit, or tipping area, provides enough space for about one day of waste storage. The refuse is lifted from the pit by a crane equipped with a bucket or grapple device. It is then deposited into a hopper and chute above the furnace and released onto a charging grate or stoker. The grate shakes and moves waste through the furnace, allowing air to circulate around the burning material. Modern incinerators are usually built with a rectangular furnace, although rotary kiln furnaces and vertical circular furnaces are available. Furnaces are constructed of refractory bricks that can withstand the high combustion temperatures.

Combustion in a furnace occurs in two stages: primary and secondary. In primary combustion, moisture is driven off, and the waste is ignited and volatilized. In secondary combustion, the remaining unburned gases and particulates are oxidized, eliminating odours and reducing the amount of fly ash in the exhaust. When the refuse is very moist, auxiliary gas or fuel oil is sometimes burned to start the primary combustion.

In order to provide enough oxygen for both primary and secondary combustion, air must be thoroughly mixed with the burning refuse. Air is supplied from openings beneath the grates or is admitted to the area above. The relative amounts of this underfire air and overfire air must be determined by the plant operator to achieve good combustion efficiency. A continuous flow of air can be maintained by a natural draft in a tall chimney or by mechanical forced-draft fans.

Energy recovery

The energy value of refuse can be as much as one-third that of coal, depending on the paper content, and the heat given off during incineration can be recovered by the use of a refractory-lined furnace coupled to a boiler. Boilers convert the heat of combustion into steam or hot water, thus allowing the energy content of the refuse to be recycled. Incinerators that recycle heat energy in this way are called waste-to-energy plants. Instead of a separate furnace and boiler, a water-tube wall furnace may also be used for energy recovery. Such a furnace is lined with vertical steel tubes spaced closely enough to form continuous sections of wall. The walls are insulated on the outside in order to reduce heat loss. Water circulating through the tubes absorbs heat to produce steam, and it also helps to control combustion temperatures without the need for excessive air, thus lowering air pollution control costs.

Waste-to-energy plants operate as either mass burn or refuse-derived fuel systems. A mass burn system uses all the refuse, without prior treatment or preparation. A refuse-derived fuel system separates combustible wastes from noncombustibles such as glass and metal before burning. If a turbine is installed at the plant, both steam and electricity can be produced in a process called cogeneration.

Waste-to-energy systems are more expensive to build and operate than plain incinerators because of the need for special equipment and controls, highly skilled technical personnel, and auxiliary fuel systems. On the other hand, the sale of generated steam or electricity offsets much of the extra cost, and recovery of heat energy from refuse is a viable solid-waste management option from both an engineering and an economic point of view. About 80 percent of municipal refuse incinerators in the United States are waste-to-energy facilities.

Composting

Another method of treating municipal solid waste is composting, a biological process in which the organic portion of refuse is allowed to decompose under carefully controlled conditions. Microbes metabolize the organic waste material and reduce its volume by as much as 50 percent. The stabilized product is called compost or humus. It resembles potting soil in texture and odour and may be used as a soil conditioner or mulch.

Composting offers a method of processing and recycling both garbage and sewage sludge in one operation. As more stringent environmental rules and siting constraints limit the use of solid-waste incineration and landfill options, the application of composting is likely to increase. The steps involved in the process include sorting and separating, size reduction, and digestion of the refuse.

Sorting and shredding

The decomposable materials in refuse are isolated from glass, metal, and other inorganic items through sorting and separating operations. These are carried out mechanically, using differences in such physical characteristics of the refuse as size, density, and magnetic properties. Shredding or pulverizing reduces the size of the waste articles, resulting in a uniform mass of material. It is accomplished with hammer mills and rotary shredders.

Digesting and processing

Pulverized waste is ready for composting either by the open windrow method or in an enclosed mechanical facility. Windrows are long, low mounds of refuse. They are turned or mixed every few days to provide air for the microbes digesting the organics. Depending on moisture conditions, it may take five to eight weeks for complete digestion of the waste. Because of the metabolic action of aerobic bacteria, temperatures in an active compost pile reach about 65 °C (150 °F), killing pathogenic organisms that may be in the waste material.

Open windrow composting requires relatively large land areas. Enclosed mechanical composting facilities can reduce land requirements by about 85 percent. Mechanical composting systems employ one or more closed tanks or digesters equipped with rotating vanes that mix and aerate the shredded waste. Complete digestion of the waste takes about one week.

Sanitary landfill

Land disposal is the most common management strategy for municipal solid waste. Refuse can be safely deposited in a sanitary landfill, a disposal site that is carefully selected, designed, constructed, and operated to protect the environment and public health. One of the most important factors relating to landfilling is that the buried waste never comes in contact with surface water or groundwater. Engineering design requirements include a minimum distance between the bottom of the landfill and the seasonally high groundwater table. Most new landfills are required to have an impermeable liner or barrier at the bottom, as well as a system of groundwater-monitoring wells. Completed landfill sections must be capped with an impermeable cover to keep precipitation or surface runoff away from the buried waste. Bottom and cap liners may be made of flexible plastic membranes, layers of clay soil, or a combination of both.

Recycling

Separating, recovering, and reusing components of solid waste that may still have economic value is called recycling. One type of recycling is the recovery and reuse of heat energy, a practice discussed separately in Incineration. Composting can also be considered a recycling process, since it reclaims the organic parts of solid waste for reuse as mulch or soil conditioner. Still other waste materials have potential for reuse. These include paper, metal, glass, plastic, and rubber, and their recovery is discussed here.

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