Cleaned Merged Topics Dataset

Key: merged_topic_0_0

Label: balance, zero, arises, interests, check, earned

Input:

<task:merge> <sos>

In its simplest form it may be viewed as an accounting procedure

For example a mass balance is performed each time a check book is balanced

However a situation may arises when there is a ZERO balance that is the rates of deposit and withdrawals are equal

In actual case a bank would not permit one to make the balance a zero

in the sense that when there is no balance or minimum balance kept just to maintain the status of the account and no interests are earned

++++

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In actual case a bank would not permit one to make the balance a zero

in the sense that when there is no balance or minimum balance kept just to maintain the status of the account and no interests are earned

This implies that there is no accumulation in the system

<eos>

Output:

In its simplest form, it may be viewed as an accounting procedure. For example, a mass balance is performed each time a check book is balanced. However, a situation may arise when there is a ZERO balance, that is, the rates of deposit and withdrawals are equal. In actual case, a bank would not permit one to make the balance a zero, in the sense that when there is no balance or minimum balance kept just to maintain the status of the account and no interests are earned. This implies that there is no accumulation in the system.

Key: merged_topic_1_0

Label: concept, problems, define, allows, place, track

Input:

Cleaned Merged Topics Dataset

<task:merge> <sos>

What this concept allows us to do is track materials that is pollutants from one place to another with mass balance equations

This concept serves as a basis for describing and analysing environmental engineering problems

What this concept allows us to do is track materials for example the pollutants from one place to another with mass balance equations

The first step a mass balance analysis is to define the particular region in the space that is to be analysed

This helps us define the problems

In other contexts such as modeling air pollution the assumption is referred to as a complete mix box model

The same simple models can be applied to certain problems involving air quality

++++

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The same simple models can be applied to certain problems involving air quality

<eos>

Output:

This concept serves as a basis for describing and analyzing environmental engineering problems. What this concept allows us to do is track materials, such as pollutants, from one place to another with mass balance equations. The first step in a mass balance analysis is to define the particular region in the space that is to be analyzed. This helps us define the problems. In other contexts, such as modeling air pollution, the assumption is referred to as a complete mix box model. The same simple models can be applied to certain problems involving air quality.

Key: merged_topic_2_0

Label: balance, material, unit, mass, volume, time

Cleaned Merged Topics Dataset

Input:

<task:merge> <sos>

The concept is called a materials balance or a mass balance

We then write material balance equations to solve for unknown inputs outputs or accumulations or to demonstrate that we have accounted for all of the components by demonstrating that the materials balance closes that is the accounting balances

Material balance with single material Material flows can be most readily understood and analysed by using the concept of a black box

If no processes are going inside the box that will either make of more material or destroy some of it and if the slow is assumed not vary with time (that is to be at steady state) then it is possible to write a material balance around the box as Fig

The black box can be used to establish a volume balance and a mass balance if the density does not change in the process

Because the definition of density is mass per unit volume the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant)

It is generally convenient to use the volume balance for liquids and the mass balance for solids

If again it is assumed that steady state conditions exist and that no material is being destroyed or produced then the material balance is X of time unit per Mass X time unit per Mass IN OUT or X X X ( ) Fig

++++

The concept is called a materials balance or a mass balance

We then write material balance equations to solve for unknown inputs outputs or accumulations or to demonstrate that we have accounted for all of the components by demonstrating that the materials balance closes that is the accounting balances

Material balance with single material Material flows can be most readily understood and analyzed by using the concept of a black box

If and if the slow is assumed not vary with time (that is to be at steady state) then it is possible to write a material balance around the box as Fig

<eos>

Output:

The concept is called a materials balance or a mass balance. We then write material balance equations to solve for unknown inputs, outputs, or accumulations, or to demonstrate that we have accounted for all of the components by showing that the materials balance closes, which means the accounting balances. Material flows, particularly with a single material, can be most readily understood and analyzed by using the concept of a black box. If no processes are going inside the box that will either make more material or destroy some of it, and if the flow is assumed not to vary with time (that is, to be at steady state), then it is possible to write a material balance around the box as Fig. The black box can also be used to establish a volume balance and a mass balance if the density does not change in the process. Because the definition of density is mass per unit volume, the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant). It is generally convenient to use the volume balance for liquids and the mass balance for solids. If again it is assumed that steady state conditions exist and that no material is being destroyed or produced, then the material balance is Mass per time unit IN equals Mass per time unit OUT, represented as X IN = X OUT (Fig).

Key: merged_topic_2_1

Label: balance, material, unit, mass, volume, time

Input:

<task:merge> <sos>

If the influents are labeled as X X Xm the material balance would yield ( ) m e i i X X Fig

Complex process with a single material The preceding two sections illustrate the basic principle of material balances

If these possibilities are included in the full material balance the equation reads time unit per Material time unit per Material time unit per Material time unit per Material time unit per Material CONSUMED PRODUCED OUT IN D ACCUMULATE If the material in question is labeled A the mass balance equation reads time unit per A of Mass time unit per A of Mass time unit per A of Mass time unit per A of Mass time unit per A of Mass CONSUMED PRODUCED OUT IN D ACCUMULATE Or provided the density does not change in volume terms as time unit per A of Volume time unit per A of Volume time unit per A of Volumen time unit per A of Volume time unit per A of Volume CONSUMED PRODUCED OUT IN D ACCUMULATE Mass or volume per unit time can be simplified to rate where rate simply means the flow of mass or volume

Thus the material balance or mass balance equation for either mass or volume reads CONSUMED A of Rate PRODUCED A of Rate OUT A of Rate IN A of Rate D ACCUMULATE A of Rate ( ) General rules in solving mass balance problems

++++

Because the definition of density is mass per unit volume the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant)

It is generally convenient to use the volume balance for liquids and the mass balance for solids

If again it is assumed that steady state conditions exist and that no material is being destroyed or produced then the material balance is Mass per unit Mass per unit time X time X OUT IN or XX X ( ) Fig

If the influents are labeled as X X Xm the material balance would yield

<eos>

Output:

The basic principle of material balances for a complex process with a single material is illustrated by its full material balance equation. This equation involves terms such as 'time unit per Material CONSUMED', 'time unit per Material PRODUCED', 'time unit per Material OUT', 'time unit per Material IN', and 'time unit per Material D ACCUMULATE'. The general equation reads: D ACCUMULATE = IN - OUT + PRODUCED - CONSUMED. If the material in question is labeled A, the mass balance equation reads: Mass of A D ACCUMULATE (time unit per A of Mass) = Mass of A IN (time unit per A of Mass) - Mass of A OUT (time unit per A of Mass) + Mass of A PRODUCED (time unit per A of Mass) - Mass of A CONSUMED (time unit per A of Mass). Or, provided the density does not change, it can be expressed in volume terms as: Volume of A D ACCUMULATE (time unit per A of Volume) = Volume of A IN (time unit per A of Volume) - Volume of A OUT (time unit per A of Volume) + Volume of A PRODUCED (time unit per A of Volume) - Volume of A CONSUMED (time unit per A of Volume). Mass or volume per unit time can be simplified to 'rate', where 'rate' simply means the flow of mass or volume. Thus, the material balance or mass balance equation for either mass or volume reads: D ACCUMULATE A of Rate = IN A of Rate - OUT A of Rate + PRODUCED A of Rate - CONSUMED A of Rate. General rules apply in solving mass balance problems. Because the definition of density is mass per unit volume, the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant). It is generally convenient to use the volume balance for liquids and the mass balance for solids. If it is assumed that steady state conditions exist and that no material is being destroyed or produced, then the material balance simplifies to Mass per unit time IN = Mass per unit time OUT, or XX X ( ) Fig. If the influents are labeled as X X Xm, the material balance would yield ( ) m e i i X X Fig.

Key: merged_topic_2_2

Label: balance, material, unit, mass, volume, time

Cleaned Merged Topics Dataset

Input:

<task:merge> <sos>

Draw the continuous dashed line around the component or components that are to be balanced

Decide what material is to be balanced

Write the material balance equation by starting with the basic equation CONSUMED A of Rate PRODUCED A of Rate OUT A of Rate IN A of Rate D ACCUMULATE A of Rate

Material balance with multiple materials Mass and volume balances can be developed with multiple materials flowing in a single system

Because the mass balance and volume balance equations are actually the same equations for a black box unless there is more than one material involved in the flow

++++

Complex process with a single material The preceding two sections illustrate the basic principle of material balances

If these possibilities are included in the full material balance the equation reads

Material per unit time ACCUMULATED Material per unit time IN Material per unit time OUT Material per unit time PRODUCED Material per unit time CONSUMED If the material in question is labeled A the mass balance equation reads Mass of A per unit time ACCUMULATED Mass of A per unit time IN Mass of A per unit time OUT Mass of A per unit time PRODUCED Mass of A per unit time CONSUMED Or provided the density does not change in volume terms as Volume of A per unit time ACCUMULATED Volume of A per unit time IN Volume of A per unit time OUT Volume of A per unit time PRODUCED Volume of A per unit time CONSUMED Mass or volume per unit time can be simplified to rate where rate simply means the flow of mass or volume

Thus the material balance or mass balance equation for either mass or volume reads Rate of A ACCUMULATED Rate of A IN Rate of A OUT Rate of A PRODUCED Rate of A CONSUMED ( ) General rules in solving mass balance problems

Draw the continuous dashed line around the component or components that are to be balanced

Decide what material is to be balanced

<eos>

Output:

General rules in solving mass balance problems include drawing a continuous dashed line around the component or components that are to be balanced and deciding what material is to be balanced. The preceding two sections illustrate the basic principle of material balances, applicable to complex processes with a single material. Furthermore, mass and volume balances can be developed with multiple materials flowing in a single system, as the mass balance and volume balance equations are essentially the same for a black box unless more than one material is involved in the flow. When writing the full material balance equation, one starts with the basic form: Material per unit time ACCUMULATED = Material per unit time IN - Material per unit time OUT + Material per unit time PRODUCED - Material per unit time CONSUMED. If the material in question is labeled A, the mass balance equation specifically reads: Mass of A per unit time ACCUMULATED = Mass of A per unit time IN - Mass of A per unit time OUT + Mass of A per unit time PRODUCED - Mass of A per unit time CONSUMED. Alternatively, provided the density does not change, in volume terms it reads as: Volume of A per unit time ACCUMULATED = Volume of A per unit time IN - Volume of A per unit time OUT + Volume of A per unit time PRODUCED - Volume of A per unit time CONSUMED. Since mass or volume per unit time can be simplified to 'rate', meaning the flow of mass or volume, the material balance or mass balance equation for either mass or volume can be concisely written as: Rate of A ACCUMULATED = Rate of A IN - Rate of A OUT + Rate of A PRODUCED - Rate of A CONSUMED.

Key: merged_topic_2_3

Label: balance, material, unit, mass, volume, time

Input:

<task:merge> <sos>

If we assume the substance is uniformly distributed throughout the volume V Thus the total mass (M) of the substance is equal to the product of the concentration and volume (V)

SO release rate is kgbrick produced and the annual brick production rate is million bricks year

Remembering that mass flow rate can be expressed as (Concentration Volume flow) we can apply a mass balance equation in terms of SO as follows

General mass balance equation of Rate SO SO of Rate SO of Rate SO of Rate SO of Rate CONSUMED PRODUCED OUT IN D ACCUMULATE Assuming steady state and the balance becomes kghr Qso mhr Therefore Qso gm

++++

Write the material balance equation by starting with the basic equation Rate of A ACCUMULATED Rate of A IN Rate of A OUT Rate of A PRODUCED Rate of A CONSUMED

Material balance with multiple materials Mass and volume balances can be developed with multiple materials flowing in a single system

If we assume the substance is uniformly distributed throughout the volume V Thus the total mass (M) of the substance is equal to the product of the concentration and volume (V)

SO release rate is kgbrick produced and the annual brick production rate is million bricks year

<eos>

Output:

If we assume the substance is uniformly distributed throughout the volume V, the total mass (M) of the substance is equal to the product of the concentration and volume (V). SO release rate is kgbrick produced, and the annual brick production rate is million bricks year. Remembering that mass flow rate can be expressed as (Concentration Volume flow), we can apply a mass balance equation in terms of SO. The basic material balance equation states: Rate of A ACCUMULATED = Rate of A IN - Rate of A OUT + Rate of A PRODUCED - Rate of A CONSUMED. When applying this general mass balance equation to SO, assuming steady state, the balance becomes kghr Qso mhr, therefore Qso gm. Moreover, mass and volume balances can be developed with multiple materials flowing in a single system.

Key: merged_topic_3_0

Label: diagram, process, imaginary, boundary, inputs, outputs, simple

Input:

<task:merge> <sos>

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

System boundaries (imaginary blocks around the process or part of the process) are drawn in such a way that calculations are made as simple as possible

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

By picturing an imaginary boundary around the region we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region

These boxes are schematic representations of real processes or flow junctions and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows

This could be a unit operation a junction or a combination of these

++++

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

System boundaries (imaginary blocks around the process or part of the process) are drawn in such a way that calculations are made as simple as possible

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

Draw the system diagram including all flows (inputs and outputs) as arrows

<eos>

Output:

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem, termed as Mass Balance Diagram. All of the known inputs, outputs, and accumulation are converted to the same mass units and placed on this diagram. System boundaries, which are imaginary blocks around the process or part of the process, are drawn in such a way that calculations are made as simple as possible. By picturing an imaginary boundary around the region, the system diagram can be drawn including all flows (inputs and outputs) as arrows, enabling the identification of the flow of materials across the boundary as well as the accumulation of materials within the region. The diagram may include anything from a simple chemical mixing tank to an entire coal-fired power plant, a lake, a stretch of a stream, an air basin above a city, or the globe itself. These boxes are schematic representations of real processes or flow junctions, and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows. This could be a unit operation, a junction, or a combination of these.

Key: merged_topic_4_0

Label: box, area, mixing, valley, velocity, black, flow, shown, fig

Input:

<task:merge> <sos>

All flows into the box are called influents and represented by the letter X

If the flow is described as mass per unit time X is the mass per unit time of material X flowing in to the box

Similarly X is the outflow or effluent

A black box with one inflow and one outflow X of time unit per Mass X time unit per Mass ( ) OUT IN or X X ( ) Eq

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By picturing an imaginary boundary around the region we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region

These boxes are schematic representations of real processes or flow junctions and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows

shows a black box into which some material is flowing

All flows into the box are called influents and represented by the letter X

If the flow is described as mass per unit time X is the mass per unit time of material X flowing in to the box

Similarly X is the outflow or effluent

A black box with one inflow and one outflow Mass per unit Mass per unit time X time X ( ) IN OUT or X X ( ) Eq

The black box can be used to establish a volume balance and a mass balance if the density does not change in the process

Splitting SingleMaterial Flow Streams A black box shown in Fig

The flow into the box is labeled X and the two flows out of the box are X and X

Combining SingleMaterial Flow Streams A black box can also receive numerous influents and discharge one effluent as shown in Fig

Assign symbols to unknown variables

Everything inside the dashed line becomes the black box

If only one variable is unknown solve for that variable

If more than one variable is unknown repeat the procedure using a different black box or a different material for the same black box

<eos>

Output:

By picturing an imaginary boundary around a region, we can identify the flow of materials across this boundary as well as their accumulation within the region. These "black boxes" are schematic representations of real processes or flow junctions, and it is not necessary to specify what this process is to develop general principles about flow analysis. Conceptually, everything inside a dashed line becomes the black box. All flows entering the box are termed influents and are represented by the letter X. If the flow is described as mass per unit time, X is the mass per unit time of the material flowing into the box. Similarly, X represents the outflow or effluent. A black box with one inflow and one outflow is typically labeled X (IN) and X (OUT) respectively. Such a black box can be used to establish a volume balance and a mass balance, provided the density does not change in the process. A black box can illustrate various flow scenarios, such as splitting single-material flow streams where one flow into the box is labeled X and two flows out of the box are labeled X and X, or combining single-material flow streams where a black box receives numerous influents and discharges one effluent. To analyze these systems, one should assign symbols to unknown variables; if only one variable is unknown, it can be solved, but if more than one variable is unknown, the procedure may need to be repeated using a different black box or a different material for the same black box.

Key: merged_topic_4_1

Label: box, area, mixing, valley, velocity, black, flow, shown, fig

Input:

<task:merge> <sos>

The flow into the box is labeled X and the two flows out of the box are X and X

The mixing height above Kathmandu Valley and Banepa urban areas is km

The length and width of the box representing the mixing zone (as shown in Fig XX) is km by km

Solution First construct the box above Kathmandu Valley and Banepa area as shown in Fig below

The volume of the air moving into the box is calculated as the velocity times the area through which the flow occurs or Q Av where v wind velocity and A area of the side of the box (mixing depth times width)

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Because the mass balance and volume balance equations are actually the same equations for a black box unless there is more than one material involved in the flow

The length and width of the box representing the mixing zone (as shown in Fig) is km by km

(Ans kgkm) First construct the box above Kathmandu Valley and Banepa area as shown in Fig below

The volume of the air moving into the box is calculated as the velocity times the area through which the flow occurs or Q Av where v wind velocity and A area of the side of the box (mixing depth times width)

Air quality box model

<eos>

Output:

Air quality box model. First, construct the box above Kathmandu Valley and Banepa area as shown in Fig below (Ans kgkm). The length and width of the box representing the mixing zone (as shown in Fig XX) is km by km, and the mixing height above Kathmandu Valley and Banepa urban areas is km. The flow into the box is labeled X, and the two flows out of the box are X and X. The volume of the air moving into the box is calculated as the velocity times the area through which the flow occurs, or Q Av, where v is wind velocity and A is the area of the side of the box (mixing depth times width). This is because the mass balance and volume balance equations are actually the same equations for a black box unless there is more than one material involved in the flow.

Key: merged_topic_5_0

Label: energy, transfer, law, created, mass, design, liquid, phase

Input:

<task:merge> <sos>

The law of conservation of mass says that mass can never be created nor destroyed

Thus the transfer of mass from one point to another in a system becomes important

In the biochemical or physical masstransfer process interphase diffusion occurs when a driving force is created by a departure from equilibrium

In the gas phase the driving force is a partial pressure gradient and in the solid or liquid phase it is the concentration gradient

There could be different mass transfer processes depending upon the underlying phases for example Gasliquid mass transfer aeration or supply of oxygen for decomposing waste Liquid gas transfer release of methane from anaerobic waste treatment Liquidliquid mass transfer extraction of organic solvents liquid phase oxygen transfer Liquidsolid mass transfer adsorption of pollutants on activated carbon solidgas mass transfer release of gases from solid wastes in a landfill Energy transfer The law of conservation of energy states that with the exception of nuclear reactions energy can neither be created nor destroyed

This energy law serves as an accounting tool in various environmental implications

Be it a metabolic reaction taking inside a cell or dispersion of air pollutants in the atmosphere or the different aspects of climate change processes a knowledge of transfer of energy is essential to understand the process dynamics

The flow of energy can be analysed through energy balance equations using the first law of thermodynamics

The first law of thermodynamics states that energy can never be created nor be destroyed

change in energy of system change in energy of surroundings Therefore when energy disappears in one form it appears in another

The total energy stored in a system is composed of internal kinetic and potential energies

++++

Thus the transfer of mass from one point to another in a system becomes important

In the biochemical or physical masstransfer process interphase diffusion occurs when a driving force is created by a departure from equilibrium

In the gas phase the driving force is a partial pressure gradient and in the solid or liquid phase it is the concentration gradient

<eos>

Output:

The law of conservation of mass states that mass can never be created nor destroyed. Thus, the transfer of mass from one point to another in a system becomes important. In the biochemical or physical mass transfer process, interphase diffusion occurs when a driving force is created by a departure from equilibrium. In the gas phase, this driving force is a partial pressure gradient, while in the solid or liquid phase, it is the concentration gradient. Depending on the underlying phases, there could be different mass transfer processes; for example, Gas-liquid mass transfer includes aeration or the supply of oxygen for decomposing waste; Liquid-gas transfer involves the release of methane from anaerobic waste treatment; Liquid-liquid mass transfer covers the extraction of organic solvents and liquid phase oxygen transfer; Liquid-solid mass transfer pertains to the adsorption of pollutants on activated carbon; and Solid-gas mass transfer relates to the release of gases from solid wastes in a landfill. Regarding energy transfer, the law of conservation of energy, also known as the first law of thermodynamics, states that with the exception of nuclear reactions, energy can neither be created nor destroyed. This energy law serves as an accounting tool in various environmental implications, where a knowledge of the transfer of energy is essential to understand process dynamics, be it a metabolic reaction taking place inside a cell, the dispersion of air pollutants in the atmosphere, or different aspects of climate change processes. The flow of energy can be analyzed through energy balance equations using the first law of thermodynamics; therefore, when energy disappears in one form it appears in another, meaning the change in energy of the system equals the change in energy of the surroundings. The total energy stored in a system is composed of internal, kinetic, and potential energies.

Key: merged_topic_5_1

Label: energy, transfer, law, created, mass, design, liquid, phase

Input:

Cleaned Merged Topics Dataset

<task:merge> <sos>

A simple interpretation of the second law of thermodynamics suggests that when work is done there will always be some inefficiency that is some portion of the energy put into the process will end up as waste heat

How the waste heat affects the environment is an important consideration in the study of environmental engineering Knowledge of mass and energy transfer in pollution control and remediation is essential to Understand the process Design the preventive measures Design the treatment units Design the remediation activities Mass balance It is well understood that matter can neither be created nor destroyed but it can be changed from one form to other

++++

There could be different mass transfer processes depending upon the underlying phases for example Gasliquid mass transfer aeration or supply of oxygen for decomposing waste Liquid gas transfer release of methane from anaerobic waste treatment Liquidliquid mass transfer extraction of organic solvents liquid phase oxygen transfer Liquidsolid mass transfer adsorption of pollutants on activated carbon solidgas mass transfer release of gases from solid wastes in a landfill Intensive properties and extensive properties are types of physical properties of matter

Knowledge of mass and energy transfer in pollution control and remediation is essential to Understand the process Design the preventive measures Design the treatment units Design the remediation activities Mass balance It is well understood that matter can neither be created nor destroyed but it can be changed from one form to other

<eos>

Output:

A simple interpretation of the second law of thermodynamics suggests that when work is done there will always be some inefficiency, meaning some portion of the energy put into the process will end up as waste heat. How this waste heat affects the environment is an important consideration in the study of environmental engineering. Knowledge of mass and energy transfer in pollution control and remediation is essential to understand the process, design the preventive measures, design the treatment units, and design the remediation activities. Mass balance highlights that matter can neither be created nor destroyed but it can be changed from one form to other. There could be different mass transfer processes depending upon the underlying phases, for example, Gas-liquid mass transfer (aeration or supply of oxygen for decomposing waste), Liquid-gas transfer (release of methane from anaerobic waste treatment), Liquid-liquid mass transfer (extraction of organic solvents or liquid phase oxygen transfer), Liquid-solid mass transfer (adsorption of pollutants on activated carbon), and solid-gas mass transfer (release of gases from solid wastes in a landfill). Intensive properties and extensive properties are types of physical properties of matter.

Cleaned Merged Topics Dataset

Key: merged_topic_6_0

Label: energy, transfer, law, created, mass, thermodynamics, destroyed

Input:

<task:merge> <sos>

The law of conservation of mass says that mass can never be created nor destroyed

Thus the transfer of mass from one point to another in a system becomes important

In the biochemical or physical masstransfer process interphase diffusion occurs when a driving force is created by a departure from equilibrium

In the gas phase the driving force is a partial pressure gradient and in the solid or liquid phase it is the concentration gradient

There could be different mass transfer processes depending upon the underlying phases for example Gasliquid mass transfer aeration or supply of oxygen for decomposing waste Liquid gas transfer release of methane from anaerobic waste treatment Liquidliquid mass transfer extraction of organic solvents liquid phase oxygen transfer Liquidsolid mass transfer adsorption of pollutants on activated carbon solidgas mass transfer release of gases from solid wastes in a landfill Energy transfer The law of conservation of energy states that with the exception of nuclear reactions energy can neither be created nor destroyed

This energy law serves as an accounting tool in various environmental implications

Be it a metabolic reaction taking inside a cell or dispersion of air pollutants in the atmosphere or the different aspects of climate change processes a knowledge of transfer of energy is essential to understand the process dynamics

The flow of energy can be analysed through energy balance equations using the first law of thermodynamics

The first law of thermodynamics states that energy can never be created nor be destroyed

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The law of conservation of mass says that mass can never be created nor destroyed

Energy transfer The law of conservation of energy states that with the exception of nuclear reactions energy can neither be created nor destroyed

This energy law serves as an accounting tool in various environmental implications

Be it a metabolic reaction taking inside a cell or dispersion of air pollutants in the atmosphere or the different aspects of climate change processes a knowledge of transfer of energy is essential to understand the process dynamics

<eos>

Cleaned Merged Topics Dataset

Output:

The law of conservation of mass says that mass can never be created nor destroyed; thus, the transfer of mass from one point to another in a system becomes important. In the biochemical or physical masstransfer process, interphase diffusion occurs when a driving force is created by a departure from equilibrium. In the gas phase, the driving force is a partial pressure gradient, and in the solid or liquid phase, it is the concentration gradient. There could be different mass transfer processes depending upon the underlying phases; for example, Gasliquid mass transfer (aeration or supply of oxygen for decomposing waste); Liquid gas transfer (release of methane from anaerobic waste treatment); Liquidliquid mass transfer (extraction of organic solvents, liquid phase oxygen transfer); Liquidsolid mass transfer (adsorption of pollutants on activated carbon); and solidgas mass transfer (release of gases from solid wastes in a landfill). Energy transfer is also a crucial concept. The law of conservation of energy states that, with the exception of nuclear reactions, energy can neither be created nor destroyed. This energy law serves as an accounting tool in various environmental implications. Be it a metabolic reaction taking inside a cell, or dispersion of air pollutants in the atmosphere, or the different aspects of climate change processes, a knowledge of transfer of energy is essential to understand the process dynamics. The flow of energy can be analysed through energy balance equations using the first law of thermodynamics, which states that energy can never be created nor be destroyed.

Key: merged_topic_6_1

Label: energy, transfer, law, created, mass, thermodynamics, destroyed

Input:

<task:merge> <sos>

change in energy of system change in energy of surroundings Therefore when energy disappears in one form it appears in another

The total energy stored in a system is composed of internal kinetic and potential energies

A simple interpretation of the second law of thermodynamics suggests that when work is done there will always be some inefficiency that is some portion of the energy put into the process will end up as waste heat

How the waste heat affects the environment is an important consideration in the study of environmental engineering Knowledge of mass and energy transfer in pollution control and remediation is essential to Understand the process Design the preventive measures Design the treatment units Design the remediation activities Mass balance It is well understood that matter can neither be created nor destroyed but it can be changed from one form to other

++++

The flow of energy can be analyzed through energy balance equations using the first law of thermodynamics

The first law of thermodynamics states that energy can never be created nor be destroyed

Change in energy of system change in energy of surroundings Therefore when energy disappears in one form it appears in another

The total energy stored in a system is composed of internal kinetic and potential energies A simple interpretation of the second law of thermodynamics suggests that when work is done there will always be some inefficiency that is some portion of the energy put into the process will end up as waste heat

How the waste heat affects the environment is an important consideration in the study of environmental engineering

<eos>

Output:

The first law of thermodynamics states that energy can never be created nor destroyed; a change in the energy of a system implies a corresponding change in the energy of its surroundings, therefore when energy disappears in one form, it appears in another. The flow of energy can be analyzed through energy balance equations using this first law. The total energy stored in a system is composed of internal, kinetic, and potential energies. Paralleling this, it is well understood that matter can neither be created nor destroyed but it can be changed from one form to another, which is essential for mass balance. A simple interpretation of the second law of thermodynamics suggests that when work is done, there will always be some inefficiency, meaning a portion of the energy put into the process will end up as waste heat. How this waste heat affects the environment is an important consideration in the study of environmental engineering. Knowledge of mass and energy transfer in pollution control and remediation is essential to understand the process, design preventive measures, design treatment units, and design remediation activities.

Key: merged_topic_7_0

Label: substances, compounds, substrate, biological, environment, conservative, nonconservative, transformed

Input:

<task:merge> <sos>

In environmental systems be it an aerobic cell participating in oxidation process or a river receiving untreated wastes the movement of nutrients substrate or metabolic products plays an important role

The extent of processes such as decomposition of wastes by microorganisms or lake eutrophication is governed by either the supply of natural or artificial oxygen or availability of substrate or nutrients

Cleaned Merged Topics Dataset

A blender with several inflows and one outflow Conservative and nonconservative substance Conservative substances are not physically or chemically transformed to other substances in normal situation

Examples are salt and metals

Nonconservative substances are transformed to other substances through physical chemical or biological processes in the environment

These include biological oxygen demand (indicator of the quantity of biologically degrading chemicals) Conservative substances tend to be stable longlived compounds that persist within environment

Nonconservative substances can transform or degrade into other compounds but the rate of transformation depends on the physical chemical and biological conditions occurring in the environment

sludge CO may be oxidized to CO) or compounds are destroyed (eg

growth of microorganisms) or disappearance (utilization of substrate) of a substance or chemical species

++++

A blender with several inflows and one outflow Conservative and nonconservative substance Conservative substances are not physically or chemically transformed to other substances in normal situation

Nonconservative substances are transformed to other substances through physical chemical or biological processes in the environment

Conservative substances tend to be stable longlived compounds that persist within environment

Nonconservative substances can transform or degrade into other compounds but the rate of transformation depends on the physical chemical and biological conditions occurring in the environment

<eos>

Output:

In environmental systems, be it an aerobic cell participating in an oxidation process or a river receiving untreated wastes, the movement of nutrients, substrate, or metabolic products plays an important role. The extent of processes such as the decomposition of wastes by microorganisms or lake eutrophication is governed by either the supply of natural or artificial oxygen, or the availability of substrate or nutrients. A system can be conceptualized as a blender with several inflows and one outflow, containing both conservative and nonconservative substances. Conservative substances are not physically or chemically transformed to other substances in normal situations; examples include salt and metals. These substances tend to be stable, long-lived compounds that persist within the environment. In contrast, nonconservative substances are transformed to other substances through physical, chemical, or biological processes in the environment. These include biological oxygen demand (an indicator of the quantity of biologically degrading chemicals). Nonconservative substances can transform or degrade into other compounds, but the rate of transformation depends on the physical, chemical, and biological conditions occurring in the environment. For example, CO may be oxidized, or compounds are destroyed (e.g., through the growth of microorganisms), or there is a disappearance (utilization of substrate) of a substance or chemical species.

Key: merged_topic_8_0

Label: substances, compounds, substrate, biological, environment, nutrients, microorganisms, wastes, oxygen

Input:

<task:merge> <sos>

In environmental systems be it an aerobic cell participating in oxidation process or a river receiving untreated wastes the movement of nutrients substrate or metabolic products plays an important role

The extent of processes such as decomposition of wastes by microorganisms or lake eutrophication is governed by either the supply of natural or artificial oxygen or availability of substrate or nutrients

A blender with several inflows and one outflow Conservative and nonconservative substance Conservative substances are not physically or chemically transformed to other substances in normal situation

Examples are salt and metals

Nonconservative substances are transformed to other substances through physical chemical or biological processes in the environment

These include biological oxygen demand (indicator of the quantity of biologically degrading chemicals) Conservative substances tend to be stable longlived compounds that persist within environment

Nonconservative substances can transform or degrade into other compounds but the rate of transformation depends on the physical chemical and biological conditions occurring in the environment

sludge CO may be oxidized to CO) or compounds are destroyed (eg

growth of microorganisms) or disappearance (utilization of substrate) of a substance or chemical species

++++

In environmental systems be it an aerobic cell participating in oxidation process or a river receiving untreated wastes the movement of nutrients substrate or metabolic products plays an important role

The extent of processes such as decomposition of wastes by microorganisms or Lake Eutrophication is governed by either the supply of natural or artificial oxygen or availability of substrate or nutrients

Examples are salt and metals

These include biological oxygen demand (indicator of the quantity of biologically degrading chemicals) ammonia and certain organic compounds

sludge CO may be oxidized to CO) or compounds are destroyed (eg

growth of microorganisms) or disappearance (utilization of substrate) of a substance or chemical species

References Bailey J E and Ollis D F ( ) Biochemical Engineering Fundamentals McGrawHill International New York Examples

<eos>

Output:

In environmental systems, be it an aerobic cell participating in oxidation processes or a river receiving untreated wastes, the movement of nutrients, substrate, or metabolic products plays an important role. The extent of processes such as decomposition of wastes by microorganisms or lake eutrophication is governed by either the supply of natural or artificial oxygen or availability of substrate or nutrients. These systems can be envisioned as a blender with several inflows and one outflow, involving both conservative and nonconservative substances. Conservative substances are not physically or chemically transformed to other substances in normal situations; they tend to be stable, long-lived compounds that persist within the environment. Examples include salt and metals. Nonconservative substances, on the other hand, are transformed to other substances through physical, chemical, or biological processes in the environment. They can transform or degrade into other compounds, but their rate of transformation depends on the physical, chemical, and biological conditions occurring in the environment. Examples of nonconservative substances include biological oxygen demand (an indicator of the quantity of biologically degrading chemicals), ammonia, and certain organic compounds. Such transformations can involve substances being oxidized (e.g., sludge CO may be oxidized to CO), compounds being destroyed (e.g., growth of microorganisms), or the disappearance (e.g., utilization of substrate) of a substance or chemical species.

Key: merged_topic_9_0

Label: concept, problems, define, allows, place, diagram, inputs, outputs, simple, process

Input:

<task:merge> <sos>

What this concept allows us to do is track materials that is pollutants from one place to another with mass balance equations

This concept serves as a basis for describing and analysing environmental engineering problems

What this concept allows us to do is track materials for example the pollutants from one place to another with mass balance equations

The first step a mass balance analysis is to define the particular region in the space that is to be analysed

This helps us define the problems

In other contexts such as modeling air pollution the assumption is referred to as a complete mix box model

The same simple models can be applied to certain problems involving air quality

++++

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

System boundaries (imaginary blocks around the process or part of the process) are drawn in such a way that calculations are made as simple as possible

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

Draw the system diagram including all flows (inputs and outputs) as arrows

<eos>

Output:

The mass balance concept serves as a basis for describing and analyzing environmental engineering problems, allowing us to track materials, such as pollutants, from one place to another using mass balance equations. The first step in a mass balance analysis is to define the particular region in space that is to be analyzed; this helps define the problems. The same simple models can be applied to certain problems involving air quality, and in other contexts, such as modeling air pollution, the assumption is referred to as a complete mix box model. This analysis is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem, termed a Mass Balance Diagram. To do this, system boundaries, which are imaginary blocks around the process or part of the process, are drawn in such a way that calculations are made as simple as possible. All known inputs, outputs, and accumulation are converted to the same mass units and placed on the diagram. This diagram may include anything from a simple chemical mixing tank to an entire coal-fired power plant, a lake, a stretch of a stream, an air basin above a city, or even the globe itself. The system diagram should always include all flows, both inputs and outputs, represented as arrows.

Key: merged_topic_10_0

Label: diagram, process, imaginary, boundary, concept, problems, place, track, allows

Input:

<task:merge> <sos>

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

System boundaries (imaginary blocks around the process or part of the process) are drawn in such a way that calculations are made as simple as possible

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

By picturing an imaginary boundary around the region we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region

These boxes are schematic representations of real processes or flow junctions and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows

This could be a unit operation a junction or a combination of these

++++

What this concept allows us to do is track materials that is pollutants from one place to another with mass balance equations

This concept serves as a basis for describing and analyzing environmental engineering problems

What this concept allows us to do is track materials for example the pollutants from one place to another with mass balance equations

This helps us define the problems

In other contexts such as modeling air pollution the assumption is referred to as a complete mix box model

The same simple models can be applied to certain problems involving air quality

<eos>

Output:

The core concept allows us to track materials, specifically pollutants, from one place to another using mass balance equations, serving as a basis for describing and analyzing environmental engineering problems and helping to define them. This tracking is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem, termed a Mass Balance Diagram. On this diagram, all known inputs, outputs, and accumulation are converted to the same mass units and placed. System boundaries, which are imaginary blocks around the process or part of the process, are drawn in such a way that calculations are made as simple as possible. By picturing an imaginary boundary around the region, we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region. These boxes are schematic representations of real processes or flow junctions, and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows; this could be a unit operation, a junction, or a combination of these. The diagram itself may include anything from a simple chemical mixing tank to an entire coal-fired power plant, a lake, a stretch of a stream, an air basin above a city, or the globe itself. In other contexts, such as modeling air pollution, the underlying assumption is referred to as a complete mix box model, and the same simple models can be applied to certain problems involving air quality.

Key: merged_topic_11_0

Label: diagram, process, imaginary, boundary, box, black, flow, shown, fig

Input:

<task:merge> <sos>

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

System boundaries (imaginary blocks around the process or part of the process) are drawn in such a way that calculations are made as simple as possible

++++

By picturing an imaginary boundary around the region we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region

These boxes are schematic representations of real processes or flow junctions and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows shows a black box into which some material is flowing

All flows into the box are called influents and represented by the letter X

If the flow is described as mass per unit time X is the mass per unit time of material X flowing in to the box

Similarly X is the outflow or effluent

A black box with one inflow and one outflow Mass per unit Mass per unit time X time X ( ) IN OUT or X X ( ) Eq

The black box can be used to establish a volume balance and a mass balance if the density does not change in the process

Splitting SingleMaterial Flow Streams A black box shown in Fig

The flow into the box is labeled X and the two flows out of the box are X and X

Combining SingleMaterial Flow Streams A black box can also receive numerous influents and discharge one effluent as shown in Fig

Assign symbols to unknown variables

Everything inside the dashed line becomes the black box

If only one variable is unknown solve for that variable

If more than one variable is unknown repeat the procedure using a different black box or a different material for the same black box

<eos>

Output:

Mass balance analysis is carried out by drawing a flowchart or a conceptual diagram of the environmental subsystem, often termed a Mass Balance Diagram. System boundaries, defined as imaginary blocks around the process or part of the process, are drawn in such a way that calculations are made as simple as possible. By picturing such an imaginary boundary around a region, one can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region. These boxes are schematic representations of real processes or flow junctions, and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows. All of the known inputs, outputs, and accumulation are converted to the same mass units and placed on the diagram. A black box represents a system into which some material is flowing; all flows into the box are called influents and are represented by the letter X. If the flow is described as mass per unit time, X is the mass per unit time of material X flowing into the box, and similarly, X is the outflow or effluent. This black box can be used to establish a volume balance and a mass balance if the density does not change in the process. For instance, a black box can illustrate splitting single-material flow streams, where the flow into the box is labeled X and the two flows out of the box are X and X. Conversely, a black box can also receive numerous influents and discharge one effluent, representing combining single-material flow streams. For the analysis of these systems, symbols are assigned to unknown variables, with everything inside the dashed line becoming the black box. If only one variable is unknown, solve for that variable; if more than one variable is unknown, repeat the procedure using a different black box or a different material for the same black box.

Key: merged_topic_11_1

Label: diagram, process, imaginary, boundary, box, black, flow, shown, fig

Input:

<task:merge> <sos>

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

By picturing an imaginary boundary around the region we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region

These boxes are schematic representations of real processes or flow junctions and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows

This could be a unit operation a junction or a combination of these

++++

Because the mass balance and volume balance equations are actually the same equations for a black box unless there is more than one material involved in the flow

The length and width of the box representing the mixing zone (as shown in Fig) is km by km

(Ans kgkm) First construct the box above Kathmandu Valley and Banepa area as shown in Fig below

The volume of the air moving into the box is calculated as the velocity times the area through which the flow occurs or Q Av where v wind velocity and A area of the side of the box (mixing depth times width)

Air quality box model

<eos>

Output:

The diagram may include anything from a simple chemical mixing tank to an entire coal-fired power plant, a lake, a stretch of a stream, an air basin above a city, or the globe itself. By picturing an imaginary boundary around the region, we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region. These boxes are schematic representations of real processes or flow junctions and could be a unit operation, a junction, or a combination of these; it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows. This concept is particularly relevant for an air quality box model. For example, one might first construct a box above the Kathmandu Valley and Banepa area, with the length and width of the box representing the mixing zone being specified as km by km. In such models, the volume of the air moving into the box is calculated as the velocity times the area through which the flow occurs, or Q = Av, where v is the wind velocity and A is the area of the side of the box (mixing depth times width). Furthermore, the mass balance and volume balance equations are actually the same equations for a black box unless there is more than one material involved in the flow.

Key: merged_topic_12_0

Label: diagram, process, imaginary, boundary, material, unit, time, balance, volume

Input:

<task:merge> <sos>

This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

System boundaries (imaginary blocks around the process or part of the process) are drawn in such a way that calculations are made as simple as possible

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

++++

The concept is called a materials balance or a mass balance

We then write material balance equations to solve for unknown inputs outputs or accumulations or to demonstrate that we have accounted for all of the components by demonstrating that the materials balance closes that is the accounting balances

Material balance with single material Material flows can be most readily understood and analyzed by using the concept of a black box

If and if the slow is assumed not vary with time (that is to be at steady state) then it is possible to write a material balance around the box as Fig

Because the definition of density is mass per unit volume the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant)

It is generally convenient to use the volume balance for liquids and the mass balance for solids

If again it is assumed that steady state conditions exist and that no material is being destroyed or produced then the material balance is Mass per unit Mass per unit time X time X OUT IN or XX X ( ) Fig

If the influents are labeled as X X Xm the material balance would yield

Complex process with a single material The preceding two sections illustrate the basic principle of material balances

If these possibilities are included in the full material balance the equation reads

<eos>

Output:

The concept is called a materials balance or a mass balance, which is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem, often termed a Mass Balance Diagram. On this diagram, all of the known inputs, outputs, and accumulation are converted to the same mass units and placed. System boundaries, defined as imaginary blocks around the process or part of the process, are drawn in such a way that calculations are made as simple as possible. The diagram's scope may range from a simple chemical mixing tank to an entire coal-fired power plant, a lake, a stretch of a stream, an air basin above a city, or the globe itself. Material flows can be most readily understood and analyzed by using the concept of a black box, around which we then write material balance equations. These equations are used to solve for unknown inputs, outputs, or accumulations, or to demonstrate that all components have been accounted for by showing that the materials balance closes, meaning the accounting balances. If the flow is assumed not to vary with time, that is to be at steady state, then it is possible to write a material balance around the box. Because the definition of density is mass per unit volume, the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant); it is generally convenient to use the volume balance for liquids and the mass balance for solids. If again it is assumed that steady state conditions exist and that no material is being destroyed or produced, then the material balance is Mass per unit time OUT equals Mass per unit time IN. If the influents are labeled as X, X, Xm, the material balance would yield. The basic principle of material balances is illustrated by these methods, and if these possibilities are included, the full material balance equation reads.

Key: merged_topic_12_1

Label: diagram, process, imaginary, boundary, material, unit, time, balance, volume

Input:

<task:merge> <sos>

By picturing an imaginary boundary around the region we can then begin to identify the flow of materials across the boundary as well as the accumulation of materials within the region

These boxes are schematic representations of real processes or flow junctions and it is not necessary to specify just what this process is to be able to develop general principles about the analysis of flows

This could be a unit operation a junction or a combination of these

++++

Material per unit time ACCUMULATED Material per unit time IN Material per unit time OUT Material per unit time PRODUCED Material per unit time CONSUMED If the material in question is labeled A the mass balance equation reads Mass of A per unit time ACCUMULATED Mass of A per unit time IN Mass of A per unit time OUT Mass of A per unit time PRODUCED Mass of A per unit time CONSUMED Or provided the density does not change in volume terms as Volume of A per unit time ACCUMULATED Volume of A per unit time IN Volume of A per unit time OUT Volume of A per unit time PRODUCED Volume of A per unit time CONSUMED Mass or volume per unit time can be simplified to rate where rate simply means the flow of mass or volume

Thus the material balance or mass balance equation for either mass or volume reads Rate of A ACCUMULATED Rate of A IN Rate of A OUT Rate of A PRODUCED Rate of A CONSUMED ( ) General rules in solving mass balance problems

Draw the continuous dashed line around the component or components that are to be balanced

Decide what material is to be balanced

Write the material balance equation by starting with the basic equation Rate of A ACCUMULATED Rate of A IN Rate of A OUT Rate of A PRODUCED Rate of A CONSUMED

Material balance with multiple materials Mass and volume balances can be developed with multiple materials flowing in a single system

<eos>

Output:

By picturing an imaginary boundary around a region, we can begin to identify the flow of materials across this boundary as well as the accumulation of materials within the region. These regions, often referred to as 'boxes,' are schematic representations of real processes or flow junctions, which could be a unit operation, a junction, or a combination of these. It is not necessary to specify the exact nature of this process to develop general principles about the analysis of flows. The fundamental material balance equation states: Material per unit time ACCUMULATED = Material per unit time

IN - Material per unit time OUT + Material per unit time PRODUCED - Material per unit time CONSUMED. If the material in question is labeled A, the mass balance equation reads: Mass of A per unit time ACCUMULATED = Mass of A per unit time IN - Mass of A per unit time OUT + Mass of A per unit time PRODUCED - Mass of A per unit time CONSUMED. Alternatively, provided the density does not change, in volume terms it reads: Volume of A per unit time ACCUMULATED = Volume of A per unit time IN - Volume of A per unit time OUT + Volume of A per unit time PRODUCED - Volume of A per unit time CONSUMED. Mass or volume per unit time can be simplified to 'rate,' where 'rate' simply means the flow of mass or volume. Thus, the material balance or mass balance equation for either mass or volume reads: Rate of A ACCUMULATED = Rate of A IN - Rate of A OUT + Rate of A PRODUCED - Rate of A CONSUMED. General rules in solving mass balance problems include: drawing a continuous dashed line around the component or components that are to be balanced; deciding what material is to be balanced; and writing the material balance equation by starting with the basic equation: Rate of A ACCUMULATED = Rate of A IN - Rate of A OUT + Rate of A PRODUCED - Rate of A CONSUMED. Finally, mass and volume balances can also be developed with multiple materials flowing in a single system.

Key: merged_topic_13_0

Label: balance, material, unit, mass, volume, diagram, inputs, outputs, simple, process

Input:

<task:merge> <sos>

The concept is called a materials balance or a mass balance

We then write material balance equations to solve for unknown inputs outputs or accumulations or to demonstrate that we have accounted for all of the components by demonstrating that the materials balance closes that is the accounting balances

Material balance with single material Material flows can be most readily understood and analysed by using the concept of a black box

If no processes are going inside the box that will either make of more material or destroy some of it and if the slow is assumed not vary with time (that is to be at steady state) then it is possible to write a material balance around the box as Fig

The black box can be used to establish a volume balance and a mass balance if the density does not change in the process

Because the definition of density is mass per unit volume the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant)

It is generally convenient to use the volume balance for liquids and the mass balance for solids

If again it is assumed that steady state conditions exist and that no material is being destroyed or produced then the material balance is X of time unit per Mass X time unit per Mass IN OUT or X X X ( ) Fig

If the influents are labeled as X X Xm the material balance would yield ( ) m e i i X X Fig

Complex process with a single material The preceding two sections illustrate the basic principle of material balances

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This is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem termed as Mass Balance Diagram

All of the known inputs outputs and accumulation are converted to the same mass units and placed on the diagram

<eos>

Output:

The concept is called a materials balance or a mass balance. Material balance equations are then written to solve for unknown inputs, outputs, or accumulations, or to demonstrate that all components have been accounted for by showing that the materials balance closes, meaning the accounting balances. Material flows, particularly with a single material, can be most readily understood and analyzed by using the concept of a black box. If no processes are going inside the box that will either make more material or destroy some of it, and if the flow is assumed not to vary with time (that is, to be at steady state), then it is possible to write a material balance around the box. The black box can be used to establish a volume balance and a mass balance if the density does not change in the process. Because the definition of density is mass per unit volume, the conversion from a mass balance to a volume balance is achieved by dividing each term by the density (a constant). It is generally convenient to use the volume balance for liquids and the mass balance for solids. If again it is assumed that steady state conditions exist and that no material is being destroyed or produced, then the material balance is Mass IN per time unit = Mass OUT per time unit. If the influents are labeled as X X Xm, the material balance would yield ( ) m e i i X X Fig. This process is carried out by drawing a flow chart of the process or a conceptual diagram of the environmental subsystem, termed a Mass Balance Diagram. All of the known inputs, outputs, and accumulations are converted to the same mass units and placed on the diagram. The preceding sections illustrate the basic principle of material balances, encompassing complex processes with a single material.

Key: merged_topic_13_1

Label: balance, material, unit, mass, volume, diagram, inputs, outputs, simple, process

Cleaned Merged Topics Dataset

Input:

<task:merge> <sos>

Thus the material balance or mass balance equation for either mass or volume reads CONSUMED A of Rate PRODUCED A of Rate OUT A of Rate IN A of Rate D ACCUMULATE A of Rate ( ) General rules in solving mass balance problems

Draw the continuous dashed line around the component or components that are to be balanced

Decide what material is to be balanced

Write the material balance equation by starting with the basic equation CONSUMED A of Rate PRODUCED A of Rate OUT A of Rate IN A of Rate D ACCUMULATE A of Rate

Material balance with multiple materials Mass and volume balances can be developed with multiple materials flowing in a single system

Because the mass balance and volume balance equations are actually the same equations for a black box unless there is more than one material involved in the flow

If we assume the substance is uniformly distributed throughout the volume V Thus the total mass (M) of the substance is equal to the product of the concentration and volume (V)

SO release rate is kgbrick produced and the annual brick production rate is million bricks year

Remembering that mass flow rate can be expressed as (Concentration Volume flow) we can apply a mass balance equation in terms of SO as follows

General mass balance equation of Rate SO SO of Rate SO of Rate SO of Rate SO of Rate CONSUMED PRODUCED OUT IN D ACCUMULATE Assuming steady state and the balance becomes kghr Qso mhr Therefore Qso gm

++++

The diagram may include anything form a simple chemical mixing tank to an entire coalfired power plant a lake a stretch of a stream an air basin above a city or the globe itself

Draw the system diagram including all flows (inputs and outputs) as arrows

<eos>

Output:

Thus, the material balance or mass balance equation for either mass or volume reads: CONSUMED A of Rate, PRODUCED A of Rate, OUT A of Rate, IN A of Rate, and D ACCUMULATE A of Rate. General rules in solving mass balance problems include drawing a system diagram, which may represent anything from a simple chemical mixing tank

to an entire coal-fired power plant, a lake, a stretch of a stream, an air basin above a city, or the globe itself. This diagram should include all flows (inputs and outputs) as arrows, with a continuous dashed line drawn around the component or components that are to be balanced. It is also necessary to decide what material is to be balanced, and then write the material balance equation by starting with this basic equation. Mass and volume balances can be developed with multiple materials flowing in a single system, as these equations are actually the same for a black box unless more than one material is involved in the flow. If a substance is uniformly distributed throughout a volume V, its total mass (M) is equal to the product of the concentration and volume (V). Remembering that mass flow rate can be expressed as (Concentration Volume flow), a mass balance equation can be applied in terms of SO as follows: CONSUMED SO of Rate, PRODUCED SO of Rate, OUT SO of Rate, IN SO of Rate, and D ACCUMULATE SO of Rate. Assuming steady state, the balance becomes kghr Qso mhr; therefore Qso gm. The SO release rate is in kg/brick produced, and the annual brick production rate is in million bricks/year.