# SOME MORE RESULTS OF SEMI* PRE- OPEN SET WITH GROUP ACTION

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**Abstract:**

The subset A of a topological space $(X, \tau)$ is called semi$^*$ pre open if $A \subset cl*(Pint(A))$. In this paper we introduced group acting on semi$^*$ pre open set, function and semi*irresolute function related theorems by using concept of semi$^*$pre open set.

**Keywords: Group acting on semi$^*$ open set, semi$^*$ -pre open set, semi$^*$ -pre open function and semi* irresolute function with topological spaces.**

## 1. Introduction

In 1963, Levine introduced the concept of semi open sets in topological spaces, Andrijevic introduced the class of semi pre open set and semi pre closed sets in topological spaces. Navalagi introduced new class of function semi pre open function, semi pre continuous function. S.Pasunkilipandian introduced new class of semi star pre open sets in topological spaces. S.Pious Missier and A.Robert introduced more function Associated with semi* pre open sets. In this paper we introduce the stronger form of semi-preopen sets, namely semi*-preopen sets, using the generalized closure operator Cl* due to W. Dunham. We investigate the properties of these sets in the light of existing concepts and results in topology. In this paper, we introduced the concept of Group acting on semi$^*$ open set, semi$^*$ pre open set, semi$^*$ pre open function and semi*irresolute function.

## 2. Preliminaries:

**Definition: 2.1**

A subset A of a topological group (X, τ) is called a semi-open set if A ⊆cl(int(A))and a semi-closed set if int(cl(A)) ⊆ A.

**Definition: 2.2**

A subset A of a topological group (X, τ) is called a pre-open set if A⊆int(cl(A)) and a pre-closed set if cl(int(A)) ⊆A

**Definition: 2.3**

The pre closure of a set A of X is the intersection of all pre closed sets that contains A and A is denoted by pCl(A).

The union of all pre open sets which are contained in A is called the pre-interior of A denoted by pInt(A).

**Definition: 2.4**

A subset A of a topological group (X, τ) is called a β-open set (semi-pre-open set)if A ⊆ cl(int(cl(A))) and a β-closed set (semipre-closed set) if int(cl(int(A))) ⊆ A.

**Definition: 2.5**

The sub set A of a topological spaces (X, τ) is called semi* pre open if $A \subset cl*(Pint(A))$.

**Definition: 2.6**

Let G be a topological group this means that G is a topological space and also a group so that the multiplication map $\mu: G \times G \to G$.

$\mu(g.h) = gh$ and the inversemap$i: G \to G$

$i(g) = g^{-1}$ are continuous.

**Definition: 2.7**

A function $g: X \to Y$ is called semi* pre open, if the image of each open set of X, is semi* pre open in Y. It is denoted by S* PO(X).

**Definition:2.8**

A subset of a topological group $(X, \tau)$ is called a group acting on semi* pre – open set if there is a pre open set $R$ in $X$ such that $R \subseteq A \subseteq cl^*(R)$.

The set of all semi*pre open set in $(X, \tau)$ is denoted by $S^*PO(X, \tau)$.

## 3. Group action of Semi* pre open set and functions

**Theorem:3.1**

For a subset $R_G$ of a topological group $(X, \tau)$, the following statements are equivalent.

(i) $R_G$ is semi* pre-open.

(ii) $R_G \subseteq cl^*(PInt(R_G))$.

(iii) $cl^*\big(PInt(R_G)\big) = cl^*(R_G)$.

**Proof:**

$(i) \Longrightarrow (ii)$ If $R_G$ is a group acting on semi*pre-open set $T_G$ in $X$ such that $T_G \subseteq R_G \subseteq cl^*(T_G)$. Now $T_G \subseteq R_G$ implies $T_G = PInt(T_G) \subseteq PInt(R_G)$ which implies that $R_G \subseteq cl^*(T_G) \subseteq cl^*(PInt(R_G))$.

$(ii) \Longrightarrow (iii)$ Assume that $R_G \subseteq cl^*(PInt(R_G))$. Then $cl^*(R_G) \subseteq cl^*\left(cl^*\big(PInt(R_G)\big)\right) = cl^*(PInt(R_G))$.

since $PInt(R_G) \subseteq R_G$. we have $cl^*(PInt(R_G)) \subseteq cl^*(R_G)$ and $cl^*\big(PInt(R_G)\big) = cl^*(R_G)$.

$(i) \Longrightarrow (ii)$ take $T_G \subseteq PInt(R_G)$. then $T_G$ is a pre open set such that $T_G \subseteq cl^*(R_G) = cl^*\big(PInt(R_G)\big) = R_G \subseteq cl^*(T_G)$ therefore $R_G$ is semi*pre-open.

**Theorem:3.2**

A group acting on union of every semi* pre- open set is semi* pre-open

**Proof:**

Let $\{R_G\}$ be a collection of semi*pre-open sets in X.

since each $R_G$ is semi* pre-open set, there is a pre open set $T_G$ in X such that

$T_G \subseteq R_G \subseteq cl^*(T_G)$. Then $\cup T_G \subseteq \cup R_G \subseteq cl^*(T_G) \subseteq cl^* \cup (T_G)$.

Hence $\cup T_G$ is semi*pre-open, since $\cup T_G$ is pre open.

**Theorem:3.3**

A topological group $(X, \tau)$. If $R_G$ is a semi* pre-open set in $X$ and $T_G$ is open in $X$ then $R_G \cap T_G$ is group acted n semi*pre open.

**Proof:**

$R_G$ is semi* pre open in $X$, there is a proper set $E_G$ in $X$

such that $E_G \subseteq R_G \subseteq cl^*(E_G)$. since $T_G$ is open, it is $\alpha$-open.

Hence $E_G \cap T_G$ is pre open. $E_G \cap T_G \subseteq R_G \cap T_G \subseteq cl^*(E_G) \cap T_G \subseteq cl^*(E_G \cap T_G)$.

Thus $R_G \cap T_G$ is group acted on semi*pre-open.

**Theorem:3.4**

A topological group $(X, \tau)$ then $E_G$ is a subset of $X$ is g acted on semi* pre-open if and only if $E_G$ contains a g acted on semi* pr-open set.

**Proof:**

Let $E_G$ is g acted on semi* pre-open then $E_G$ contains a semi* pre open set.

$E_G$ itself about each of its points on the other hand let $x \in E_G$.

Then by assumption there is a semi*pre open set $T_G$ containing $x$ such that $T_G \subseteq E_G$.

Then $\cup \{T_G : x \in E_G\} = E_G$.

Therefore $E_G$ is group acted on semi* pre-open.

**Definition:3.5**

The semi*pre interior of $A$ is defined as the union of all semi* pre open sets of $X$ contained in $A$ and is denoted by $S^*PInt(A)$.

**Example:3.6**

Let $X = \{ 1,2,3,4 \}$

$\tau = \{\emptyset, \{1\}, \{2\}, \{1,2\}, \{1,2,3\}, X \}$ here $\{1,4\}$ and $\{2,4\}$ are semi*- pre open set but their intersection $\{4\}$ is not semi* pre open.

**Theorem:3.7**

A topological group $(X, \tau)$ then $E_G$ is a subset of $X$ is g acted on semi* pre-open if and only if every point $E_G$ is g acted on semi*-pre interior point of $E_G$.

**Proof:**

If $E_G$ is semi*-pre open then every point of $E_G$ is semi*-pre interior point.

Conversely, every point of $E_G$ is semi* pre interior point of $E_G$ implies that $E_G$ is contains a g acted on semi* pre open set about each of its points.

Therefore $E_G$ is semi* pre open.

**Theorem: 3.8**

If $T_G$ is any subset of $X$ then g acted on $S^*PInt\ (T_G)$ is semi*pre open. In fact it is the largest semi*pre-open set contained in $T_G$.

**Proof:**

$S^*PInt\ (T_G)$ is the union of semi*pre open subset of $T_G$.

It is semi* pre open Also it contain all semi* pre open, Also it contains all semi* pre open subset of $T_G$.

**Theorem:3.9**

A subset $T_G$ of $X$ is g acted on semi*pre open if and only if $S^*PInt\ (T_G) = T_G$.

**Proof:**

$T_G$ is semi*pre open implies $S^*PInt\ (T_G) = T_G$ follows from definition,

conversely, let $S^*PInt\ (T_G) = T_G$.

$S^*PInt\ (T_G)$ is semi*pre open and hence $T_G$ is semi* pre open.

**Theorem:3.10**

If $T_G$ is a subset of $X$, then g acted $S^*PInt\ (T_G)$ is the set of all semi*pre open interior points of $T_G$.

**Proof:**

$X \epsilon S^*PInt\ (T_G)$ if and only if $X$ belongs to semi*pre open subset $E_G$ of $T_G$

that is if and only if $X$ is a g acted on semi* pre interior point of $T_G$.

**Theorem:3.11**

(i) A group acting on every semi* pre open set is semi pre open.
(ii) A group acting on every pre open set is semi*pre open.
(iii) A group acting on every open set is semi*pre open.

**Proof:**

(i) Let $T_G$ be a semi*pre open set. Then there exists a pre open set $E_G$

such that $E_G \subseteq T_G \subseteq cl^*(E_G)$. since $cl^*(T_G) \subseteq cl(E_G)$,

$E_G \subseteq T_G \subseteq cl(E_G)$. Thus $T_G$ is semi*pre open.

(ii) If $T_G$ is a pre open set then $PInt(T_G) = T_G$ and $T_G \subseteq cl^*(PInt(T_G))$. Hence $T_G$ is semi*pre open.

(iii) If $T_G$ is a open set. since every open set is pre open

Therefore $T_G$ is semi* pre open set.

**Example:3.12**

In the topological group $(X, \tau')$ where $X = \{1,2,3,4\}$ and $\tau' = \{\emptyset, \{1\}, \{2,3,4\}, X\}$

Here $PO\ (X, \tau') = S^*PO\ (X, \tau') = SPO\ (X, \tau')$.

**Example: 3.13**

In the topological group $(X, \tau')$ where $X = \{1,2,3,4\}$ and $\tau' = \{\emptyset, \{1\}, \{2\}, \{1,2\}, \{2,3\}, \{1,2,3\}, X\}$.

$SPO(X, \tau') = S^*PO\ (X, \tau')$
$= \{\emptyset, \{1\}, \{2\}, \{1,2\}, \{1,4\}, \{2,3\}, \{2,4\}, \{1,2,3\}, \{1,2,4\}, \{2,3,4\}, X\}$

Here $\tau' \subsetneq S^*PO(X, \tau') = SPO\ (X, \tau')$.

**Theorem:3.14**

If $(X, \tau')$ is a topological group then $\tau_{s*p}'$ is a topology on $X$ and is finer then $\tau$.

**Proof:**

clearly $\emptyset$ and $X \in \tau_{s*p}'$. Let $E_i \in \tau_{s*p}'$ and $E_G = \cup E_i$

since $E_i \in \tau_{s*p}'$, then $E_i \in S^*PO\ (X, \tau')$

Let $R \in S^*PO\ (X, \tau')$, then $E_i \cap R \in S^*PO\ (X, \tau')$ for each $i$ and

Hence $E_G \cap R = \cup\ (E_i) \cap R = \cup\ (E_i \cap R) \in S^*PO\ (X, \tau')$ Thus $E \in \tau_{s*p}'$

Now let $E_1, E_2, E_3, \dots \dots E_n \in \tau_{s*p}'$ then $E_1, E_2, E_3, \dots \dots E_n \in S^*PO\ (X, \tau')$

by definition of $\tau_{s*p}'$, $R \cap E_i \in \tau_{s*p}'$ for every $R \in S^*PO\ (X, \tau')$ .

If $R \in S^*PO\ (X, \tau')$ then by repeated application of the condition we have

$(\cap\ E_i) \cap R \in S^*PO\ (X, \tau')$.

Hence $\cap\ E_i \in \tau_{s*p}'$ . so $\tau_{s*p}'$ is a topology on $X$. Let $T \in \tau'$ by using the theorem every open set is semi*pre open, $T \in S^*PO\ (X, \tau')$ by theorem 3 $T \cup R \in S^*PO\ (X, \tau')$

for all $R \in S^*PO\ (X, \tau')$.

Hence $T \in \tau_{s*p}'$. Thus $\tau_{s*p}'$ is finer then $\tau'$.

**Example :3.15**

The topological group $(X, \tau')$ where $X = \{\ 1,2,3,4\ \}$ and $\tau' = \{\ \emptyset, \{1\}, \{2\}, \{1,2\}, \{1,2,3\}, X\ \}$.

Hence $S^*PO\ (X,\tau') = \{\emptyset,\{1\},\{2\},\{1,2\},\{1,4\},\{2,4\},\{1,2,3\},\{1,2,4\},X\}$ and $\tau_{s*p}' = \{\emptyset,\{1\},\{2\},\{1,2\},\{1,2,3\},\{1,2,4\},X\}$, here $\tau' \subsetneq \tau_{s*p}'$.

**Theorem:3.16**

Let $R_G$ be g acted on semi*pre open of $T_G \subseteq X$ such that $R_G \subseteq T_G \subseteq cl^*(R_G)$ then $T_G$ is g acted on semi* pre open.

**Proof:**

$R_G$ be g acted on semi*pre open then $cl^*(R_G) = cl^*(PInt(R_G))$

since $R_G \subseteq T_G$, $PInt(R_G) \subseteq PInt(T_G)$ and hence $cl^*\big(PInt(R_G)\big) \subseteq cl^*\big(PInt(T_G)\big)$

Now $T_G \subseteq cl^*(R_G) \subseteq cl^*\big(PInt(R_G)\big) \subseteq cl^*\big(PInt(T_G)\big)$.

Hence $T_G$ is g acted on semi*pre open.

**Theorem:3.17**

If $(X,\tau')$ is a topological group. Let $R_G$ be a collection of subset in $(X,\tau')$ Satisfying (i) $PO(X,\tau') \subseteq R_G$ (ii) If $T_G \in R_G$ and $E_G \subseteq X$ such that $T_G \subseteq E_G \subseteq cl^*(T_G)$.

Then $E_G \in R_G$ , $S^*PO\ (X,\tau') \subseteq R_G$. In fact $S^*PO(X,\tau')$ is the smallest collection satisfying the condition (i) and (ii).

**Proof:**

Every pre open set is semi*pre open, $S^*PO(X,\tau')$ satisfies condition (i) and (ii)

Suppose $R_G$ is any collection satisfying (i) and (ii). If $T_G \in S^*PO(X,\tau')$ then there is a semi*pre open set $E_G$ in $X$ such that $E_G \subseteq T_G \subseteq cl^*(E_G)$ by (i) $E_G \in R_G$ and

by (ii) $T_G \in R_G$. Hence $S^*PO\ (X,\tau') \subseteq R_G$ and this concludes the proof.

**Example:3.18**

In the topological group $(X,\tau')$ where $X = \{1,2,3,4\}$ and $\tau' = \{\emptyset,\{1\},\{2\},\{1,2\},\{1,2,3\},X\}$ the subset $\{1,4\}$ is semi-open but not semi*pre open.

**Example:3.19**

In the topological group $(X,\tau')$ where $X = \{1,2,3,4\}$ and $\tau' = \{\emptyset,\{1,2\},\ X\}$ the subset $\{1,3\}$ is semi*-pre open but not semi open.

## 4. Group Acting of Semi*irresolute function

**Definition:4.1**

A function $g: X \to Y$ is said to be semi*-continuous if $f^{-1}(V)$ is semi*- open in $X$ for every open set $V$ in $Y$.

**Definition:4.2**

A function $g: X \to Y$ is said to be semi*-irresolute if $f^{-1}(V)$ is semi*- open in $X$ for every open set $V$ in $Y$.

**Definition:4.3**

A function $g: X \rightarrow Y$ is said to be contra semi*-irresolute if $f^{-1}(V)$ is semi*-closure in $X$ for every semi*- open set $V$ in $Y$.

**Theorem:4.4**

A group acting on every semi*irresolute function is semi*-continuous.

**Proof:**

Let $g: X \rightarrow Y$ be semi*-irresolute . Let $R$ be open in $Y$.

Then $R$ is semi*-open. since $g$ is semi*-irresolute, $g^{-1}(R)$ is semi*-open in $X$.

Thus $g$ is semi*- continuous.

**Remark:** If is not true that group acting of every semi*-continuous function is semi*-irresolute.

**Example:4.5**

Let $X = \{1,2,3,4\}$ and $\tau = \tau_1 = \{\emptyset, \{1\}, \{2\}, \{1,2\}, \{1,2,3\}, X\}$

Let $g: (X, \tau) \rightarrow (X, \tau_1)$ be definition by $g(1) = 1, g(2) = 2, g(3) = 4,$ $g(4) = 2$. Then $g$ is semi*-continuous Here $\{1,4\}$ is semi*-open $(X, \tau_1)$ but $g^{-1}(1,4) = \{1,3\}$ is not semi*-open in $(X, \tau)$. Therefore $g$ is not semi*-irresolute.

**Theorem:4.6**

A group acting on every constant function is semi*-irresolute .

**Proof:**

Let $g: X \rightarrow Y$ be a constant function defined by $g(x) = y_1$, for all $x$ in $X$, where $y_1$ is a fixed point in $Y$. Let $R$ be semi*-pre open set in $Y$. Then $g^{-1}(R) = X$ or $\emptyset$ according as $y_1 \in R$ or $y_1 \notin R$. Thus $g^{-1}(R)$ is semi*-open in $X$. Hence $g$ is group action on semi*-irresolute.

**Theorem:4.7**

If $X$ and $Y$ are topological group. Let $g: X \rightarrow Y$ be a function. Then the following are equivalent.

(i) $g$ is group acted on semi*-irresolute.
(ii) $g$ is group acted on semi* irresolute at each point of $X$.
(iii) $g^{-1}(R_G)$ is group acted on semi*-closed in $X$ for ecery semi*-closed set $R_G$ in $Y$.
(iv) $g(S^*(cl(T_G))) \subseteq S^*cl(g(T_G))$ for every subset $T_G$ of $X$.
(v) $S^*cl(g^{-1}(E_G)) \subseteq g^{-1}(S^*cl(E_G))$ for every subset $E_G$ of $Y$.
(vi) $Int^*\left(cl\left(g^{-1}(R_G)\right)\right) = Int^*\left(g^{-1}(R_G)\right)$ for every semi*-closed set $R_G$ in $Y$.
(vii) $cl^*\left(Int\left(g^{-1}(F_G)\right)\right) = cl^*\left(g^{-1}(F_G)\right)$ for every semi*-open set $F_G$ in $Y$.

**Proof:**

$(i) \Rightarrow (ii)$ Let $g: X \rightarrow Y$ be g acted on semi*-irresolute. Let $x \epsilon X$ are $F_G$ be a semi*-open set in $Y$ containing $g(x)$ thus $x \in g^{-1}(F_G)$ since $g$ is semi*-irresolute,

$S_G = g^{-1}(F_G)$ is a semi*-open set containing $x$ such that $g(S_G) \subseteq F_G$. This proves (ii).

$(ii) \Rightarrow (iii)$ Let $R_G$ be a semi*-closed set in $Y$. Then $F_G = Y\backslash R_G$ is semi*-open in $Y$. Let $x \epsilon g^{-1}(F_G)$, then $g(x) = R_G$. by assumption, there is a semi*-open set $S_G$ in $X$ containing $x$ such that $g(x) \subseteq g(S_x) \subseteq F_G$. This implies that $S_x \subseteq g^{-1}(F_G)$.

Hence $g^{-1}(F_G) = \cup \{ S_x : x\epsilon\, g^{-1}(F_G)\}$ by using theorem $g^{-1}(F_G)$ is semi*-open in $X$.

Therefore $g^{-1}(R_G) = g^{-1}(Y\backslash F_G) = X\backslash g^{-1}(F_G)$ is semi*-closed. Thus proves (iii)

$(iii) \Rightarrow (iv)$ Let $T_G \subseteq X$. Let $R_G$ be a semi*-closed set contains $g(T_G)$. then by (iii)

$g^{-1}(R_G)$ is a semi*-closed set that contains $T_G$ this implies that

$S^*cl(T_G) \subseteq g^{-1}(R_G) \Rightarrow g(S^*cl(T_G)) \subseteq R_G$. This implies that $g(S^*cl(T_G)) \subseteq S^*cl(g(T_G))$.

$(iv) \Rightarrow (v)$ Let $E_G \subseteq Y$ and $T_G = g^{-1}(E_G)$, by assumption

$g(S^*cl(T_G) \subseteq S^*cl(g(T_G)) \subseteq S^*cl(E_G)$ This implies that $S^*cl(T_G) \subseteq g^{-1}(S^*cl(E_G))$.

Hence $S^*cl(g^{-1}(E_G)) \subseteq g^{-1}(S^*cl(E_G))$.

$(v) \Rightarrow (vi)$ Let $R_G$ be a semi*-closed set in $Y$. Then by (ii) $S^*cl(R_G) = R_G$ and hence by (v) $S^*cl\left(g^{-1}(R_G)\right) \subseteq g^{-1}\left(S^*cl(R_G)\right) = g^{-1}(R_G)$.

But always $g^{-1}(R_G) \subseteq S^*cl\left(g^{-1}(R_G)\right)$. Therefore $S^*cl\left(g^{-1}(R_G)\right) = g^{-1}(R_G)$

Hence by (ii) $g^{-1}(R_G)$ is semi*-closed. Therefore $Int^*\left(cl\left(g^{-1}(R_G)\right)\right) = Int^*(g^{-1}(R_G))$.

$(vi) \Rightarrow (vii)$ Let $F_G$ be a semi*-open set in $Y$. Then $Y\backslash F_G$ is semi*-closed in $Y$.

By assumption $Int^*\left(cl\left(g^{-1}(Y\backslash F_G)\right)\right) = Int^*(g^{-1}(Y\backslash F_G))$

This implies that $Cl^*\left(Int\left(g^{-1}(F_G)\right)\right) = Cl^*(g^{-1}(F_G))$.

$(vii) \Rightarrow (i)$ Let $F_G$ be any semi*-open set in $Y$.

Then $Cl^*\left(Int\left(g^{-1}(F_G)\right)\right) = Cl^*(g^{-1}(F_G))$ therefore $g^{-1}(F_G)$ is semi*-open in $X$.

Hence $g$ is group acted on semi*-irresolute

## 5. CONCLUSION

In this paper we have introduced various set and functions associated with semi*-pre open sets and investigated their properties, concepts and results available in the literature. More over we introduce the concepts of group actions of related to semi*-open set, semi*-pre open set, semi*-pre open functions and semi* -irresolute function of topological spaces. Further study several topics in group actions of topological spaces.

## 5. REFERENCES

[1] D.Andrijevic, semi-pre open sets, mat. vesnik 38 (1986), no.1, 24-32.
[2] N.Biswas, On some mappings in topological spaces, Bull.Calcuta Math. Soc. 61(1969), 127-135.
[3] N.Levine, semi –open sets and semi-continuty in topological spaces, Amer. Math. Monthly 70. (1963), 36-41.
[4] G.B.Navalagi, semi-preneighbourhoods and generalized semi-preregular closed sets in topological spaces, Topology Atlas Preprint #455.
[5] G.B.Navalagi, Semi pre continuous functions and properties of Generalized semi pre closed sets in Topological spaces, IJMMS 29:2 (2002) 85-98.
[6] Caldas M., Weak and Strong forms of irresolute maps, Internat. J. Math. & Math. Sci. 23(4) (2000) 253-259.
[7] Pious Missier, S., and Robert, A., On Semi*-open Sets, International Journal of Mathematics and Soft Computing, 2(1), 2012, 95-102.
[8] Pious Missier, S. and Robert, A., Functions Associated with Semi*-open Sets, (IJSIMR) Volume 2, Issue 5, May 2014, PP 460-468
[9] Robert, A. and Pious Missier, S., On Semi*-closed sets, Asian Journal Of Current Engineering And Maths., 1 (4) (2012), 173-176.
[10] S.Sivakumar, P.Palanichamy, On orbit space of b-compact Group action, Acta cieneia India, Vol. XXXVII M.No. 4, 813(2011).
[11] S.Sivakumar, T.Ramanathan, Group action on Semi-pre open set and functions Journal of Xi'an University of Architecture & Technology, Volume XII, Issue IV, 2020, ( 5749-5754)
[12] S.Sivakumar, T.Ramanathan, Group action of some Topological spaces Via supra $\boldsymbol{B}$ -open and supra $\boldsymbol{\beta}$- open sets AEGAEUM JOURNAL, volume 8, Issue 6, 2020, ( 201-208)